

MRC-66....

Communication Central

automatic switching

FAIR RADIO SALES CO., INC.
P.O. Box 1105
Lima, Ohio 45802
(419) 227-6573



MOTOROLA INC.

WESTERN MILITARY ELECTRONICS CENTER

OPERATION AND MAINTENANCE MANUAL

For

Communication Central System AN/MRC-66 ()

Translation Equipment

SUPPLEMENT TO BOOKS 1 AND 2

COMMUNICATION CENTRAL AN/MRC-66() SUBSCRIBER EQUIPMENT

COMMUNICATION CENTRAL AN/MRC-66() CENTRAL EQUIPMENT



**MANUFACTURED BY
MOTOROLA, INC.**

CONTRACTS NO. DA-36-039-SC-72346

31 JULY 1959

TABLE OF CONTENTS

	<u>Paragraph</u>	<u>Page</u>
CHAPTER 1. INTRODUCTION.		
<u>Section I.</u> General.		
Scope	1	1
<u>II.</u> Description and data.		
Purpose of equipment	2	1
System application	3	1
System operation description	4	2
Lists of components	5	7
System description	6	7
CHAPTER 2. OPERATING INSTRUCTIONS.		
<u>Section I.</u> Modes of operation.		
General	7	13
Monitoring	8	13
Calling	9	13
Answering a call	10	13
Duplex operation	11	14
Subscriber	12	14
Central station	13	17
Automatic switchboard	14	17
Subscriber station operation	15	17
Central station	16	18
CHAPTER 3. THEORY OF OPERATION.		
<u>Section I.</u> Introduction.		
Scope	17	19
Supplementary data	18	19
Power distribution and control circuits	19	20
Subscriber control head	20	20
Subscriber decoder chassis	21	37
Subscriber noise blanker	22	38
Central station translation equipment	23	38
Receiver and SSB generator audio amplifier cabinet	24	41
Central station decoder chassis	25	41
Dial translator, theory of operation	26	42

TABLE OF CONTENTS (contd)

	<u>Paragraph</u>	<u>Page</u>
CHAPTER 3. THEORY OF OPERATION (contd).		
<u>Section I.</u> Introduction (contd).		
Line translator	27	52
Tone generator	28	60
Power supplies	29	60
One-line manual switchboard . . .	30	69
Central station noise blanker . .	31	70
CHAPTER 4. MAINTENANCE.		
<u>Section I.</u> Troubleshooting.		
General	32	83
<u>II.</u> Alignment procedures.		
General	33	83
Subscriber control head, maintenance data	34	83
Receiver and SSB generator audio amplifier cabinet	35	84
CHAPTER 5. DRAWINGS.		
General	36	93

LIST OF ILLUSTRATIONS

<u>Fig. No.</u>	<u>Title</u>	<u>Page</u>
1	Radio Central System	
2	Communication Central AN/MRC-66() Sub- scriber Equipment	3/4
3	Communication Central AN/MRC-66() Central Equipment	5-6
4	Communication Central Frequency Assignment . .	10
5	Radio Central System With Automatic Dialing .	15/16
6	Block Diagram Of Radio Central System	21/22
7	Subscriber Control Head	25/26
8	Subscriber Control Head, Internal View	29/30
9	Subscriber Control Head, Component Board . . .	31/32
10	Subscriber Decoder And Audio Amplifier, Top View	33/34
11	Subscriber Decoder And Audio Amplifier, Bottom View	35/36
12	Subscriber Noise Blanker Chassis, Top View . .	39/40
13	Noise Blanker Chassis, Bottom View	39/40
14	Receiver And SSB Audio Amplifier Cabinet . . .	43/44
15	Central Station Decoder Chassis, Top View . .	45/46
16	Central Station Decoder Chassis, Bottom View .	47/48
17	Central Station Decoder Chassis, Bottom View, Without Terminal Boards	49/50
18	Dial Translator, Single Channel Components Board	53/54
19	Line Translator (Single Channel) Components Board, Front View	55/56
20	Line Translator (Single Channel) Components Board, Back View	57/58
21	Tone Generator, Top View	61/62
22	Tone Generator, Bottom View	63/64
23	Tone Generator, Single Tone Oscillator	65/66
24	Tone Generator, 300-Cycle Oscillator And Multivibrator	67/68
25	200-Volt Power Supply, Top View	71/72
26	200-Volt Power Supply, Bottom View	73/74
27	One-Line Manual Switchboard	75/76
28	One-Line Manual Switchboard, Top View	77/78
29	Central Station VHF Receiver And Noise Blanker, Top View	79-80
30	Central Station VHF Receiver And Noise Blanker, Bottom View	81/82
31	Subscriber Control Head, Relay Connection . .	85/86
32	Control Head, Schematic Diagram	95/96
33	Control Head, Component Board Schematic Diagram	97/98
34	Subscriber Decoder And Audio Amplifier, Schematic Diagram	99/100

LIST OF ILLUSTRATIONS (contd)

<u>Fig. No.</u>	<u>Title</u>	<u>Page</u>
35	Subscriber Noise Blanker And Receiver Modification	101/102
36	Radio Central Automatic Dialing Trans- lation Equipment, Operational Block Diagram (Single Channel)	103/104
37	Interconnecting Diagram, Intracabinet Signal Radio Central Equipment	105/106
38	Translation Equipment Intracabinet Cabling Diagram (Power)	107/108
39	Translation Equipment Intracabinet Cabling Diagram (Signaling)	109/110
40	Receiver And SSB Audio Amplifier Schematic Diagram	111/112
41	Receiver And SSB Generator Audio Amplifier Cabinet, Cabling Diagram	113/114
42	Central Station Decoder Chassis, Schematic Diagram	115/116
43	Dial Translator (Single Channel), Schematic Diagram	117/118
44	Dial Translator Intrachassis Cabling Diagram	119/120
45	Line Translator (Single Channel), Schematic Diagram	121/122
46	Line Translator Intrachassis Cabling Diagram	123/124
47	Tone Generator Schematic Diagram	125/126
48	200-Volt Power Supply Schematic Diagram .	127/128
49	Transistorized High-Current Regulated Power Supply	129/130
50	One-Line Manual Switchboard Block-Diagram	131/132
51	One-Line Manual Switchboard Schematic Diagram	133/134
52	Central Station Noise Blanker Schematic Diagram	135/136
53.	Central Station Decoder Chassis, Bottom View	137/138

LIST OF TABLES

<u>Table</u>		
I	Subscriber Channel Assignments	9
II	Digital and Signaling Tones	51
III	Subscriber Control Head, Voltage Monitoring Points	87

The diagram illustrates the AN/MRC-66 Communication Central system. At the top center is the **COMMUNICATION CENTRAL**, represented by a truck. To its left is a **RADIO RELAY** station (labeled 5) and to its right is a **SUBSCRIBER STATION** (labeled 1). Below the Communication Central is a **RADIO RELAY TERMINAL** box, connected to the central unit by three parallel lines. Further down and to the left is another **RADIO RELAY** station (labeled 32). At the bottom left is the **RTX** (Radio Transmitter) box, connected to the Communication Central by a single line. An arrow points from the top left towards the Communication Central. The entire system is shown within a large, irregular boundary.

AN/MRC - 66
COMMUNICATION
CENTRAL

FIGURE 1 RADIO CENTRAL SYSTEM

CHAPTER 1
INTRODUCTION
SECTION I. GENERAL

1. SCOPE

This technical manual contains instructions for the operation and maintenance of the Translation Equipment that is required to modify the Communication Central System AN/MRC-66 (fig. 1) for operation with automatic switchboards. This manual is a supplement to books 1 and 2, the Communication Central AN/MRC-66 () Subscriber Equipment, and Communication Central AN/MRC-66 () Central Equipment (figs. 2 and 3). The radio communication link of the Central station and the Subscriber station remains basically the same as described in the Central and Subscriber Communication Central AN/MRC-66 () manuals.

SECTION II. DESCRIPTION AND DATA

2. PURPOSE OF EQUIPMENT

The purpose of the Translation Equipment is to provide direct dialing facilities for telephone service via radio circuits. The objective is to furnish essentially the same type of telephone service that is normally provided with wire lines when direct dialing is available, but to provide it to subscribers that are mobile and cannot be served with wire lines. The central Translation Equipment described in this manual will be installed in the three-quarter ton truck now being used for the communication Central equipment. Eight, full-duplex channels are provided for subscriber use. These channels are on a two party-line basis.

3. SYSTEM APPLICATION

A complete system consists of sixteen Subscriber stations and one Central station. A primary and an alternate channel is provided to each Subscriber station. Subscribers operate through the station switchboard to communicate with other subscribers. A subscriber may dial on either of two assigned channels, but the subscriber called must be on his primary channel when called. Full-duplex operation is provided. Each subscriber is alerted by a signalling bell when called by another subscriber.

A net position is provided to permit the Subscriber stations to communicate directly with other Subscriber stations. In the event of failure of a Central station, use of the net position would continue the Subscriber communication facilities. The net position provides simplex operation and the "push-to-talk" switch must be used.

4. SYSTEM OPERATION DESCRIPTION

a. Radio Subscriber Sets. The radio Subscriber sets have been modified to operate in a manner equivalent to a four-wire telephone set of the type described in Signal Corps Technical Requirements SCL-1759. The dialing from the Subscriber sets is accomplished using four audio tones of 800, 1000, 1200, and 1400 cps (spaced 200 cycles apart). These tones, which are transmitted sequentially in combinations of two tones for each digit, are converted in frequency and changed to compound tones and then presented to the automatic switchboard at the Central station. The table below shows the signal code sent from the Subscriber stations.

<u>Basic Tones</u>	<u>Frequency (cps)</u>
A	1400
B	1200
C	1000
D	800

<u>Tone Combinations</u>	<u>Digits</u>
AD	0
BA	1
CA	2
DA	3
AB	4
DB	5
DB	6
AC	7
BC	8
DC	9
BD	Recall
D	Seizure
C	Release

The ten digits of 0 to 9 and the recall tones are sent from the Subscriber by means of push buttons located on the Control Head. The recall push button is used to alert the operator at the base station when a Subscriber wants additional help in making a call. The seizure tone is sent automatically by the Subscriber station when the transmitter is first turned on. The purpose of this tone is to secure an unoccupied highway path through the switchboard at the base station. The release tone is sent by the subscriber when the hand set is placed on the hook. This tone releases the switchboard highway path for the use of other subscribers.

b. Central Station. The Translator at the base station converts the "two-out-of-four" sequential tone method of dialing to the "two-out-of-five" compound tone method of dialing required



Figure 2. Communications Central AN/MRC-66()
Subscriber Equipment



Figure 3. Communication Central AN/MRC-66 ()
Central Equipment

by the automatic switchboard. Each tone of the sequential two-tone combinations is sent for a duration of approximately 150 milliseconds on one of the eight radio-frequency channels.

5. LISTS OF COMPONENTS

a. The following pieces of equipment are in addition to those listed in the Communication Central AN/MRC-66 () Central Equipment manual.

<u>Quantity</u>	<u>Item</u>
1	Equipment mounting rack.
1	Dial Translator chassis
1	Line Translator chassis
2	Decoder chassis
1	Tone Generator chassis
1	Manual Switchboard and Test Set
2	Low-voltage, high-current, transistorized, Regulated Power Supplies
1	200-volt Power Supply chassis
1	Receiver and SSB Generator Channel Audio Amplifier cabinet.

b. The following pieces of equipment have been removed from the 3/4-ton truck: Hybrid Cabinet, Signalling Cabinet, and Manual Telephone Switchboard SB-86/P.

c. The following pieces of equipment are used in addition to those listed in the Communication Central AN/MRC-66 () Subscriber Equipment manual: (1) Control Head with dialing facilities to replace former Control Head, and (2) Audio Amplifier and Signalling Tone Decoder to replace former Decoder chassis mounted in the Receiver cabinet.

6. SYSTEM DESCRIPTION

The sixteen Subscriber stations in this system are standardized, and the voice-frequency channels have been pre-set in each Subscriber station. For details of frequency allocation, see figure 4. The allocations represent a change as shown in the Communication Central AN/MRC-66 () Subscriber Equipment. The most significant difference is that the reference carrier of the radio Central station has been moved into the middle of the radio-frequency voice channels. Several subscribers may talk simultaneously without cross-talk through the use of SSB techniques and channel allocation (see Table I).

a. Subscriber Equipment Description. The Subscriber Receiver

equipment remains the same as described under Item 8 of the Communication Central AN/MRC-66 () Subscriber Equipment manual with the exception of the Decoder chassis and the noise blanker chassis.

- (1) Decoder. The new Decoder chassis fits into the space formerly occupied by the original Decoder chassis, and contains a differential selective alarm circuit tuned to either 1000 or 1200 cps. The two frequencies provide selective ringing on a two-party line basis when two subscribers are assigned the same channel. The Decoder also contains an audio amplifier for use with the loud speaker. The cable and plug connections are the same as those used with the Subscriber Receiver when it was used with manual switching, with the exception of a few minor changes in the receiver chassis.
- (2) Noise blanker. The noise blanker chassis fits into the space formerly occupied by the blank chassis in the vhf and audio unit of the Subscriber Receiver chassis. The noise blanker was added to the Subscriber Receiver so that impulse noise interference that is so troublesome to SSB communications could be suppressed.
- (3) Control Head. The Control Head, with the associated hang-up switch and dialing push buttons, is mounted on the instrument panel of the jeep above and to the left of the Control Head used for the manual switching system. Electrically, this unit is the control and switching unit for the power input and for the audio and push button dialing. The cable and connecting plug that was used with the original Control Head is also used with this unit.
- (4) Transmitter, Power Supply, and accessory equipment. The transmitter, power supply, and other accessory equipment is the same as described in the Communication Central AN/MRC-66 () Subscriber Equipment manual.

b. Central Station Equipment. All transmitting, receiving, power supply, and accessory equipment remain as described in the Communication Central AN/MRC-66 () Central Equipment. Manual Telephone Switchboard SB-86/P has been removed from the 3/4-ton truck, and a noise blanker chassis has been added to the vhf receiver.

(1) Translation Equipment rack.

- (a) Tone Decoder chassis. Each r-f channel output is connected to a set of four differential selective tone decoders after passing through a channel line amplifier. The decoders are tuned to the four tones: 800, 1000, 1200, and 1400 cycles. Each of the eight r-f channels sets of decoders is identical.

TABLE I
SUBSCRIBER CHANNEL ASSIGNMENTS

Subscriber Number	Channel - 1 xtal	Channel - 2 xtal	Net xtal	Decoder freq.
1	A 475 kc	B 469 kc	418 kc	1000 cps
2	A 475	B 469	↓	1200
3	B 469	C 463		1000
4	B 469	C 463		1200
5	C 463	D 457		1000
6	C 463	D 457		1200
7	D 457	E 445		1000
8	D 451	E 445		1200
9	E 445	F 439		1000
10	E 445	F 439		1200
11	F 439	G 433		1000
12	F 439	G 433		1200
13	G 433	H 427		1000
14	G 433	H 427		1200
15	H 427	A 475		1000
16	H 427	A 475		1200

- (b) Dial Translator Chassis. Each of the eight r-f channels at the Central station receiver is provided with a Dial Translator. (The dialing tones, seizure tone, release tone, and recall tones are converted to compound tones by means of the Dial Translator.
- (c) Line Translator chassis. Each of the eight r-f channels at the Central station receiver is provided with a Line Translator. The Line Translator provides the switching so the received signal from the base station receiver may be presented to the switchboard on a two-party-line basis. This unit also provides means for sending dial tone, digit acknowledgement tone, and busy tone to a calling Subscriber, and the ringing tone to a called Subscriber.
- (d) Tone Generator chassis. The Tone Generator is common to all the r-f channels. This unit provides the oscillators and mixing circuits that produce the compound tones required by the Stromberg-Carlson automatic switchboard. These high-frequency tones, which range from 1700 to 2900 cycles, are mixed together in combinations of two tones and connected to the Dial Translator. Other tones generated in the Tone Generator unit are as follows:
1. 600-cycle busy tone (1/2 second on and 1/2 second off)
 2. 1000- and 1200-cycle ringing tones

3. 600-cycle steady tone
4. 300-cycle digit acknowledgement tone.

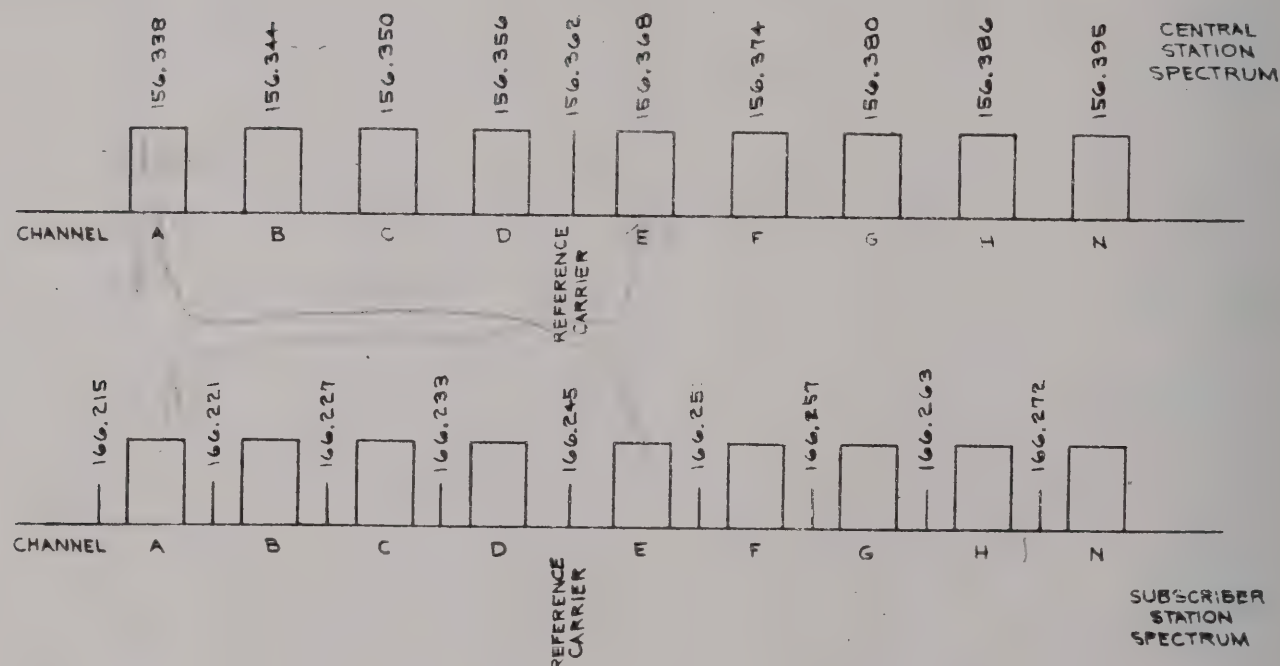


Figure 4. Communication Central Frequency Assignment

- (e) High-Voltage Power Supply chassis. Two 200-volt power supplies contained on one chassis provide the high-voltage and filament power for the vacuum tube circuits in the Translator Equipment rack.
- (f) Low-Voltage Supply chassis. Two low-voltage, transistorized, high-current regulated power supplies provide the 11-volt and 4-volt sources for the transistor circuitry in the Translator Equipment rack.
- (g) Receiver and SSB Audio Amplifier Cabinet. This audio amplifier unit provides audio amplification between the Translation Equipment, with each channel receiver, and with each channel SSB generator.

(h) Manual One-Line Switchboard and Test Set. The manual switchboard provides manual switching at the Central station without the automatic switchboard on a one-channel-at-a-time basis. With this provision, a complete systems check of the radio Central system is possible independently of the automatic switchboard. This type of operation requires an operator at the Central station, and only one subscriber may dial at one time with this arrangement.

CHAPTER 2
OPERATING INSTRUCTIONS
SECTION I. MODES OF OPERATION

7. GENERAL

This section presents the modes of operation for Subscribers and station. Refer to the block diagram, figure 5, which shows the basic circuitry involved.

8. MONITORING

a. Subscriber. The operator of any Subscriber station can monitor one side only of the conversation on a busy channel. Setting the selector switch to a busy channel will permit the operator to monitor the conversation from the Central station. The Subscriber occupying the same channel may be heard at reduced level by means of side tone through the automatic switchboard.

b. Central Base Station. The Central operator can monitor one Subscriber at a time by connecting his headset to the proper jack on the one-line manual switchboard test set, or he can monitor a Subscriber at the automatic switchboard by making the proper connections to his handset.

9. CALLING

a. Subscriber. The routine for making a call is as follows. The operator takes his handset off the hook switch and listens to determine if the channel is busy. If the channel is not busy the transmitter power switch may be turned on. This results in a seizure tone being sent. Push-button dialing may begin after reception of the dial tone from the Central station.

b. Central Base Station. The Central operator may call a Subscriber by patching the cord of the one-line manual switchboard test set to the desired Subscriber jack, and then pushing the ringing button of the desired Subscriber. A Subscriber may also be called from the automatic switchboard. Instructions for the accomplishment of this are provided with the switchboard.

10. ANSWERING A CALL

a. Subscriber. An incoming call is indicated by the ringing of the alarm bell in the decoder circuit inside the receiver cabinet. The operator removes the handset from the hook switch, thereby stopping the alarm, after which conversation with the calling party may be carried on. A Subscriber station can only be called on its primary channel. Each Subscriber is automatically restored to the primary channel when the hand set is placed on the hook switch.

b. Central Base Station. The Central base station is not normally called by the Subscriber stations when direct dialing is being used; however, the Central base station can be called by a Subscriber station by dialing the recall button on the Control Head. When this is done, a recall indicator light comes on at the switchboard.

11. DUPLEX OPERATION

a. Subscriber. Full-duplex operation is provided on the primary and secondary channels. Duplex operation is not provided on the netting channel.

b. Central Base Station. Full-duplex operation is provided on primary and secondary channels, but netting is not a provision in the Central base station. Netting is used when the Central base station is inoperative or under other emergency conditions.

SECTION II. CONTROLS AND INSTRUMENTS

12. SUBSCRIBER

All of the normal operational controls are located on the front panel of the Control Head and are of the push-button type, with the exception of the POWER and AUDIO switches and the VOLUME control. The controls associated with frequency injection level, etc., are located in the cabinets. These controls are preset and require no manipulation by the operator. The following controls and indicators are contained on the Control Head together with the dialing digit push buttons 0 to 9, and the recall button:

POWER ON-OFF switch and indicator light (green).

TRANSMITTER ON push button and indicator light (red).

AUDIO ON-OFF switch (Speaker ON-OFF switch).

CHAN 1 push button and indicator light 1 (amber)

CHAN 2 push button and indicator light 2 (amber)

EMER NET channel push button and indicator light N (amber)

VOLUME control

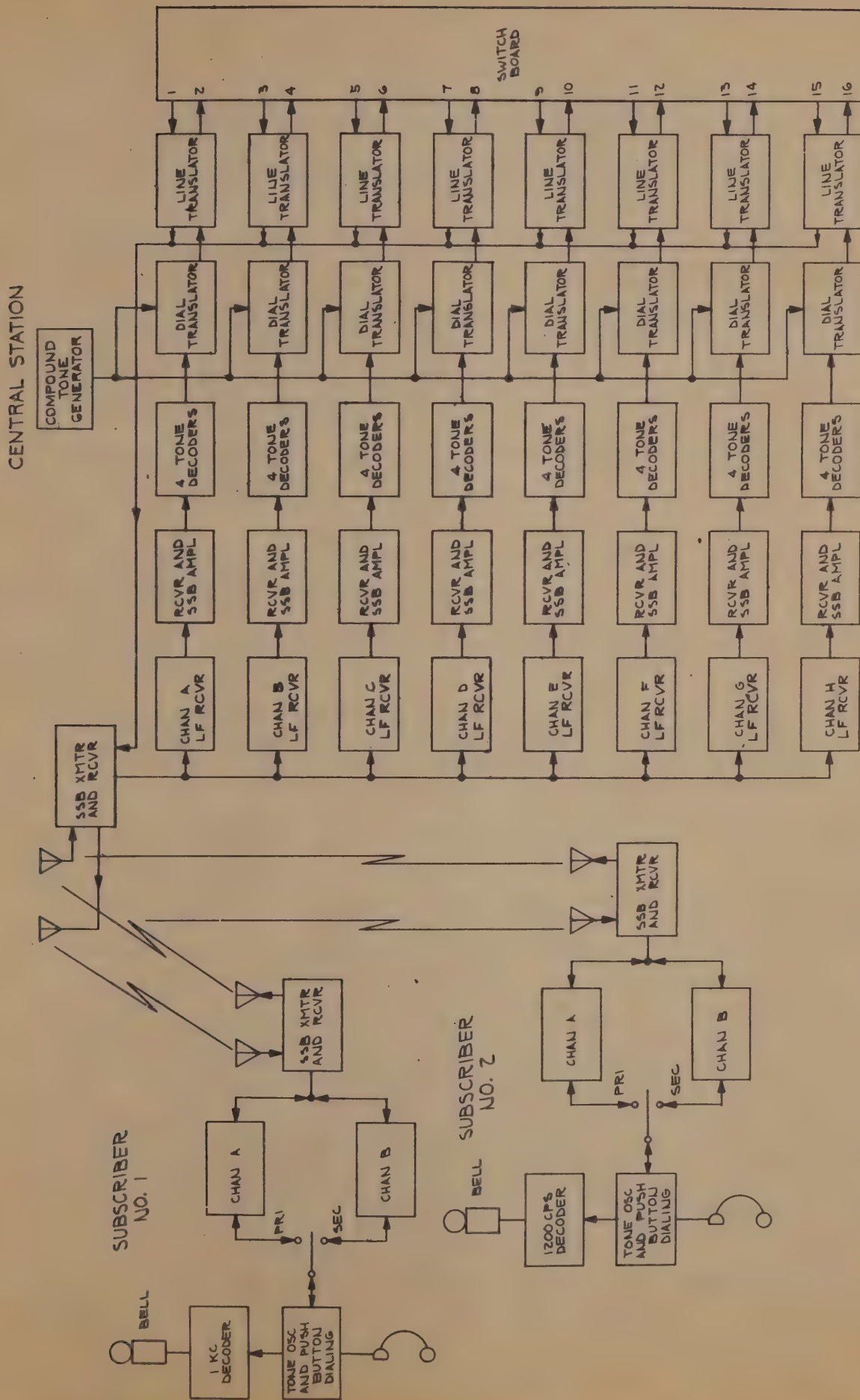


Figure 5. Radio Central System With Automatic Dialing

Two AUDIO connectors (connected in parallel for speaker or handset plug).

Handset hang up switch and handset cradle
(on top of Control Head)

13. CENTRAL STATION

All of the normal operational controls are located on the main power panel and the Translator Equipment cabinet. The controls associated with frequency, etc., are located in the cabinets and require no manipulation by the operator.

14. AUTOMATIC SWITCHBOARD

Operating instructions for this switchboard are contained in the manual on the automatic switchboard.

SECTION III. OPERATION

15. SUBSCRIBER STATION OPERATION

Operation of the Subscriber sets involve the following procedures:

a. Position the POWER ON-OFF switch at the ON position. The AUDIO ON-OFF switch should be at the ON position if speaker operation is desired. Rotate the VOLUME control to its mid-scale position, and thereafter set this control to the desired level.

b. To initiate a call, the Subscriber operator performs the following:

- (1) Remove the handset from the hang-up switch and monitor channel 1 to see if it is busy. If channel 1 is busy, push the CHAN 2 button and listen to determine whether or not channel 2 is busy.
- (2) If either of the channels are available, press the TRANSMITTER ON button. This action will turn on the transmitter and dynamotor and send out a seize signal to the radio Central and the automatic switchboard.
- (3) When the dial tone is received, the desired number may be dialed by pressing a digit button and holding it down for 1 second. When the 300-cycle digit acknowledgment tone is received, the next digit may be dialed. Refer to paragraph 4a for description of dialing code.
- (4) Replacing the handset on the hang-up switch sends out a

release tone, turns off the transmitter and dynamotor, and restores the Subscriber receiver circuits for channel 1 operation.

c. Operate the POWER ON-OFF switch to the OFF position when the Subscriber set is to be shut down.

16. CENTRAL STATION

In normal operation, the main power breaker is used to turn the equipment on and off. The Translator Equipment cabinet has a main power switch at the left side of the cabinet, ON-OFF power switches on the Power Supply Vacuum Tube unit panel, and each of the two Transistorized Power Supply units have an un-labelled power switch at the lower left side of the panel. These switches should be initially placed at the ON position, and then power application thereafter controlled by the POWER SWITCH (main power breaker). To place the equipment in operation, perform the following:

- a. Position the POWER SWITCH at the OFF position.
- b. Start the generator and set the voltage level at 117 volts.
- c. Raise the antenna to the desired elevation.
- d. Check to see that the cabinet power switches are in the ON position.
- e. Position the POWER SWITCH at the ON position (after one minute the time delay relay will energize).
- f. Refer to the Central Equipment handbook for the remaining operation procedures. See paragraph 10 of that handbook.

CHAPTER 3
THEORY OF OPERATION
SECTION I. INTRODUCTION

17. SCOPE

System theory as presented in the Communication Central AN/MRC-66 () Subscriber and Central station equipment manuals provide an understanding of how the several units are inter-related in the various operations of the radio sets. There will be no duplication of this information in this supplement, except where the information is applicable to the equipment used for automatic switching. Complete details on the individual units used for direct dialing and translating are contained in this chapter and Chapter 4, Maintenance.

18. SUPPLEMENTARY DATA

The system block diagram (fig. 6) and the Subscriber and Central schematic and wiring diagrams are listed in the following:

<u>Fig. No.</u>	<u>Title</u>	<u>Page</u>
	<u>System</u>	
6	Block Diagram of Radio Central System	21/22
	<u>Subscriber</u>	
32	Subscriber Control Head, Schematic Diagram	95/96
33	Subscriber Control Head, Component Board Schematic	97/98
34	Subscriber Decoder And Audio Amplifier Chassis, Schematic Diagram	99/100
35	Subscriber Noise Blanker, Schematic Diagram	101/102
	<u>Central Station Equipment</u>	
37	Intracabinet Signaling Radio Central Equipment, Interconnecting Diagram	105/106
38, 39	Translation Equipment Power, Intracabinet Cabling Diagram	107/108
40	Receiver And SSB Amplifier, Schematic Diagram	111/112
41	Receiver And SSB Amplifier Cabinet, Cabling Diagram	113/114
42	Central Station Decoder, Schematic Diagram	115/116
43	Dial Translator Single Channel, Schematic Diagram	117/118
44	Dial Translator Intrachassis, Cabling Diagram	119/120

<u>Fig. No.</u>	<u>Title</u>	<u>Page</u>
	<u>Central Station Equipment (cont)</u>	
45	Line Translator Single Channel, Schematic Diagram	121/122
46	Line Translator, Intrachassis Cabling Diagram	123/124
47	Tone Generator, Schematic Diagram	125/126
48	200-Volt Power Supply, Schematic Diagram	127/128
49	Low-Voltage Transistorized High-Current Regulated Power Supply, Schematic Diagram	129/130
51	One-Line Manual Switchboard, Schematic Diagram	133/134
52	Central Station Noise Blanker, Schematic Diagram	135/136

19. POWER DISTRIBUTION AND CONTROL CIRCUITS

a. Subscriber Equipment. The source of power for this equipment is a heavy-duty generator provided with the vehicle. Low-voltage power for the control circuits is taken from the vehicle electrical system. Power from the vehicle generator is delivered to the power supply cabinet. Further distribution of power and the control circuits is shown in figure 4.1 and associated drawings of the Communication Central AN/MRC-66 () Subscriber Equipment manual.

b. Central Equipment. The source of power for this equipment is a generator driven by a gasoline engine and mounted in a trailer. Power from this generator is delivered to the control panel, main power for further distribution. Details of power distribution is displayed in figure 4.7 of the Communication Central AN/MRC-66 () Central Equipment manual.

SECTION II. COMPONENT THEORY

20. SUBSCRIBER CONTROL HEAD

The push buttons and control switches of the Subscriber Control Head provide the facilities for automatic dialing. The Control Head (figures 7, 8, and 9) is mounted on the dashboard of the Subscriber instrument panel. The schematic diagram for the Control Head and component board are shown in figures 32 and 33.

a. Operating Functions.

- (1) The POWER ON-OFF switch operates the power relay K₁ located in the power supply (see figure 4.11C of the Subscriber Equipment manual) which supplies 27 volts

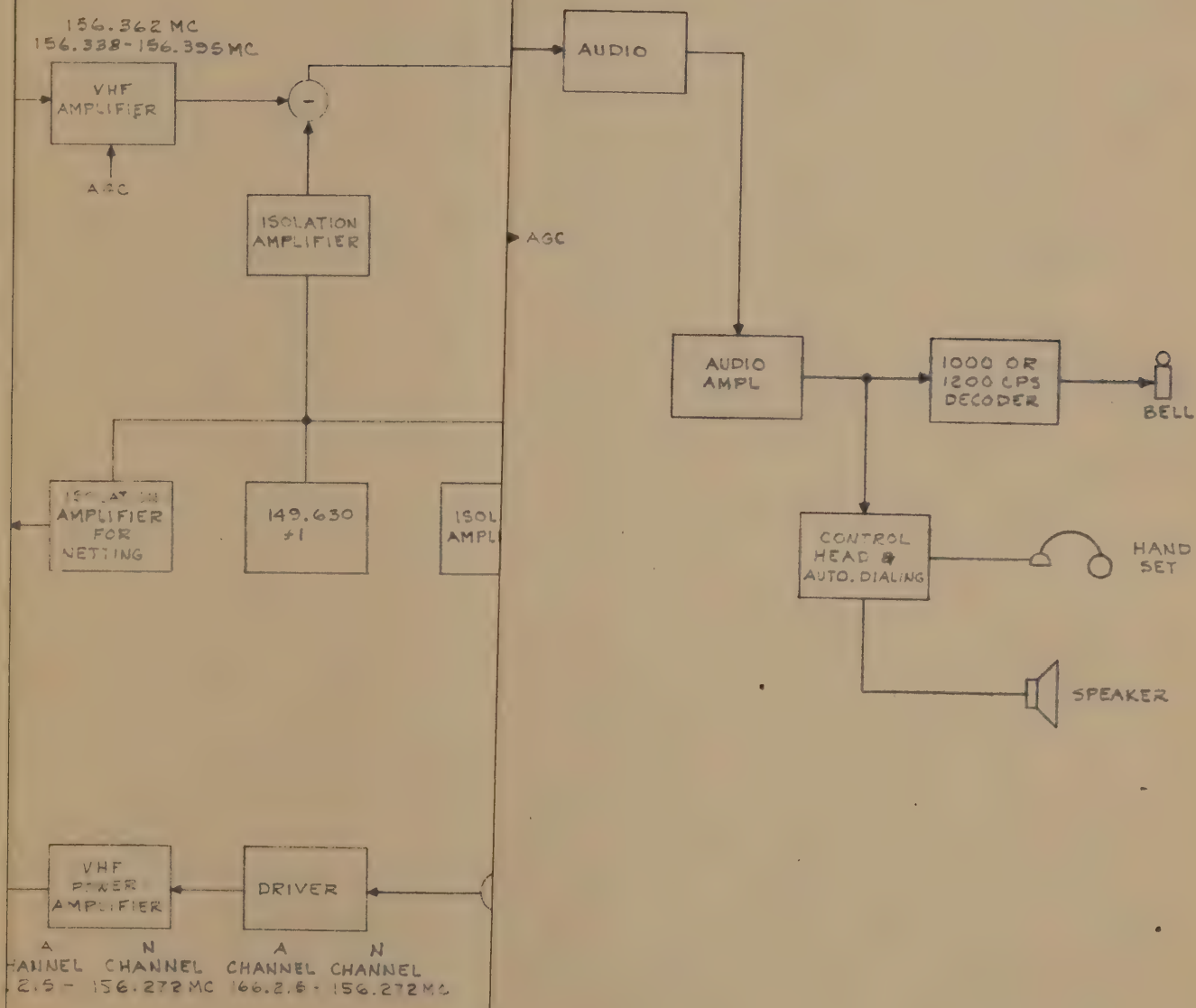


Figure 6. Block Diagram Of Radio Central System

<u>Fig. No.</u>	<u>Title</u>	<u>Page</u>
<u>Central Station Equipment (cont)</u>		
45	Line Translator Single Channel, Schematic Diagram	121/122
46	Line Translator, Intrachassis Cabling Diagram	123/124
47	Tone Generator, Schematic Diagram	125/126
48	200-Volt Power Supply, Schematic Diagram	127/128
49	Low-Voltage Transistorized High-Current Regulated Power Supply, Schematic Diagram	129/130
51	One-Line Manual Switchboard, Schematic Diagram	133/134
52	Central Station Noise Blanker, Schematic Diagram	135/136

19. POWER DISTRIBUTION AND CONTROL CIRCUITS

a. Subscriber Equipment. The source of power for this equipment is a heavy-duty generator provided with the vehicle. Low-voltage power for the control circuits is taken from the vehicle electrical system. Power from the vehicle generator is delivered to the power supply cabinet. Further distribution of power and the control circuits is shown in figure 4.1 and associated drawings of the Communication Central AN/MRC-66 () Subscriber Equipment manual.

b. Central Equipment. The source of power for this equipment is a generator driven by a gasoline engine and mounted in a trailer. Power from this generator is delivered to the control panel, main power for further distribution. Details of power distribution is displayed in figure 4.7 of the Communication Central AN/MRC-66 () Central Equipment manual.

SECTION II. COMPONENT THEORY

20. SUBSCRIBER CONTROL HEAD

The push buttons and control switches of the Subscriber Control Head provide the facilities for automatic dialing. The Control Head (figures 7, 8, and 9) is mounted on the dashboard of the Subscriber instrument panel. The schematic diagram for the Control Head and component board are shown in figures 32 and 33.

a. Operating Functions.

- (1) The POWER ON-OFF switch operates the power relay K₁ located in the power supply (see figure 4.11C of the Subscriber Equipment manual) which supplies 27 volts

to the various Subscriber equipment chassis and Control Head.

- (2) When the handset is off the hook, a ground circuit is completed to the Control Head circuitry.
- (3) Channel selection is accomplished by grounding the cathode circuit of the proper oscillator in the frequency correction unit. (See figure 4.4D of the Subscriber equipment manual). This is accomplished by the channel selector push buttons on the Control Head and relays K1 and K2.
- (4) Relay K3 is operated by pressing the TRANSMITTER ON push-button and is held by contacts 13 and 15. These same contacts also complete the ground circuit to turn on the transmitter plate relay and dynamotor.
- (5) When the handset is returned to its hang-up position, the ground circuit is completed through normally-closed contact of the 3-second time delay relay K4.
 - (a) The release tone circuit is operated by completing a ground path through the hang-up switch contacts C and D.
 - (b) Contacts F and E of the hook switch supply +26 volts to the heater of the 26C3T time-delay relay K4, causing its contacts to open after 3 seconds, which releases all energized relays, turns off the transmitter, and returns the receiver to channel 1, thus removing the operating voltages to transistor terminal board in the Control Head.
- (6) Push-to-talk relay K5 is operated by the push-to-talk switch on the handset. This mutes the speaker while transmitting to avoid acoustical feedback between speaker and handset transmitter.
- (7) The VOLUME control is an 8-ohm T pad which allows the output amplifier to work into a constant load and permits the selection of any desired audio level.
- (8) Operating voltages for the transistor circuits are obtained from CR1 (15V) and CR2 (11V) Zener diodes and series current-limiting resistors R1 and R2.
- (9) The terminal board contains the transistorized oscillator, timing circuits, tone, and output gates. The oscillator operates continuously when the handset is removed from the hang-up switch. The timing circuit controls the operation of the tone gates which switch additional capacitors across the oscillator tuned circuit

to give the correct sequential tones, and the operation of output gates which switches the oscillator output to an emitter follower circuit.

b. Oscillator Circuit. The oscillator circuit is composed of transistors Q1, Q2 and Q3, diode CR14, toroid L, and capacitor CA, ballast lamp 6S6, and associated resistors and capacitors. Transistor Q1 is a voltage amplifier, Q2 is an emitter-follower, and Q3 acts as a dynamic load for Q2 by coupling a small signal from the collector of Q2 to the base of Q3. A push-pull effect is obtained which reduces the second harmonic distortion. The ballast lamp 6S6 controls the positive feedback and, due to its non-linear voltage resistance characteristics, maintains constant amplitude of oscillation for a given setting of the feedback control R71. A 1.0 henry toroid with its blocking capacitor C6 and the associated shunt capacitance, determined by digit buttons and operation of tone gates G1 and G2, form the parallel-tuned circuit which is in the negative feedback path. Diode CR14 prevents collector current from flowing in Q1 during EMERGENCY NET operation.

c. Output Gate. Transistor Q4 is the output gate and when operated by the diode OR gate connects the oscillator output to the emitter follower Q5. The diode OR gate CR10, CR11, and CR12 operates Q4 when the seize tone gate, release tone gate, or digit gates G1 or G2 operate. The emitter follower Q5 matches the output impedance to the output gate. Output control R72 allows the output level to be set to the desired value.

d. Digit Buttons. There are three sets of contacts on the digit buttons. One set completes an 11-volt path which operates the digit timing circuit, the second set of contacts switches the proper capacitor to tone gate G1. The digit button must remain depressed until the two sequential tones have been set, which is half a second or until the digit acknowledgement tone is received.

e. Digit Timing Circuit.

- (1) The digit timing circuit is composed of transistors Q7, Q8, Q9, Q10 and Q11, diodes CR4, CR5, CR6 and CR7, time delay resistors R19 and R25, time delay capacitors C9 and C10, and associated resistors. Operating one of the digit buttons supplies 11 volts to the base resistor R15 and Q7 causing it to conduct as its base is now at a higher potential than its emitter. When Q7 conducts, its collector voltage decreases from 15 volts to 3.5 volts, which allows time delay capacitor C9 to discharge through time delay resistor R19. After 150 milliseconds, the voltage has decreased sufficiently to allow base current of Q8 to flow through CR5 causing Q8 to conduct which increases the voltage of its collector from 2 volts to 11 volts. This 11-volt collector voltage is applied to the base resistor R31 of tone gate G1



Figure 7. Subscriber Control Head

and to the base resistor R21 of Q9 causing it to conduct. Conduction of Q9 decreases its collector voltage from 15 volts to 3.5 volts, which allows the time delay capacitor C10 to discharge through time delay resistor R25. After 120 milliseconds, the voltage decreases sufficiently to allow base current of Q10 to flow through CR7, causing Q11 to conduct, which increases the voltage at its collector from 2 volts to 11 volts. This 11-volt collector voltage is applied to base resistor R29 of Q11 causing it to be cut off. When Q11 is cut off, its collector voltage decreases from 11 volts to 6 volts. The collector of Q11 is connected to the emitter of Q16, which is in the circuit of tone gate C2.

- (2) When the digit button is released the 11 volts is removed from the base resistor R15 of Q7 and the reverse series of operations occur. Transistor Q7 is cut off and its collector voltage raises to 15 volts charging time delay capacitor C9 through CR4 in 50 milliseconds, cutting off Q10 which causes Q11 to conduct. The presence of CR4 and CR6 shunting time delay resistor R19 and R21 allows a much faster recovery time than if the time through the time delay capacitors had to charge through the time delay resistor. Base bias resistors R21, R27, and R30 are connected to 15 volts to prevent I_{CO} variations from causing Q8, Q10, and Q11 to conduct.

f. Tone Gate G1.

- (1) The circuit of tone gate G1 is composed of transistors Q12, Q12 and Q14 and their associated resistors. The pressing of a digit button supplies 11 volts to the emitter of Q12. The base resistor R31 is connected to the collector of Q8 which is normally cut off. Due to current flowing from the 15-volt buss through base bias resistor R32, base resistor R31, and Q8 collector resistor R22, the voltage at the base of Q12 is 6.5 volts which allows base current to flow causing Q12 to conduct. The collector voltage of Q12 increases from 0.1 to 11 volts causing Q13 to conduct. Conduction of Q13 lowers its collector voltage from 15 to 5 volts. The collector of Q13 is connected to base resistor R38 of gate transistor R14 and diode CR10. The 5-volt collector causes the OR gate to operate the output gate Q4 and allows base current of Q14 to follow causing it to conduct. When Q14 conducts, it connects whichever capacitor the digit button has connected to line C1 to the oscillator, decreasing its frequency to the correct value for the first digit tone.
- (2) After 150 milliseconds, when the time delay capacitor C9 has discharged sufficiently to allow Q8 to conduct, its

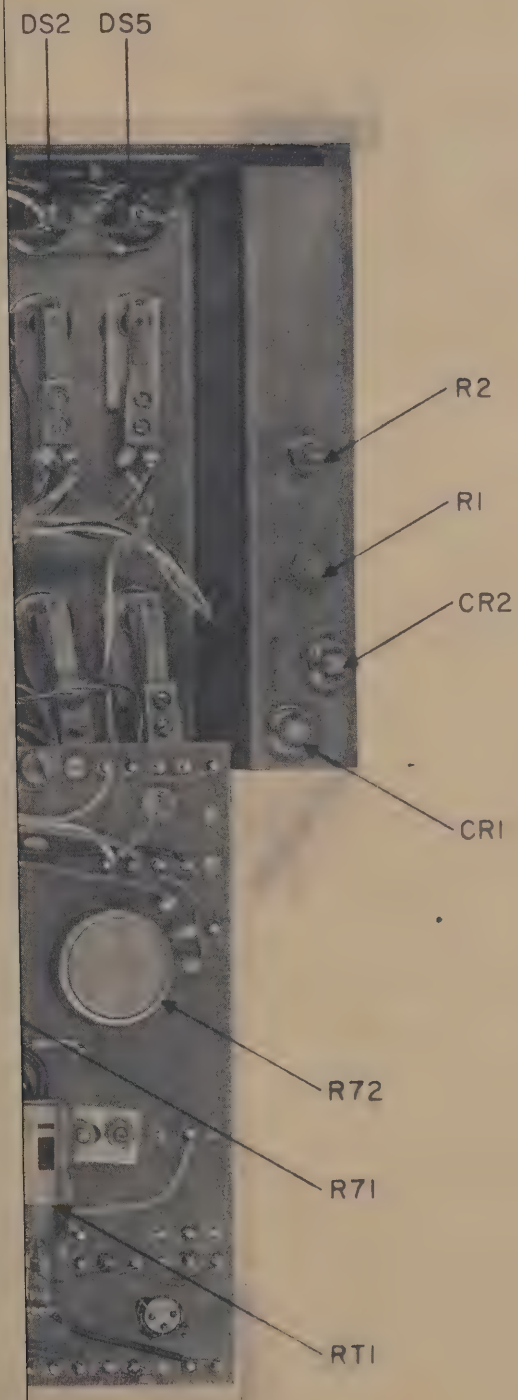
collector voltage increases from 2 to 11 volts and is applied to base resistor R31 of Q12. This cuts off Q12 causing collector voltage of Q12 to decrease from 11 to 0.1 volts which cuts off Q13. The collector voltage of Q13 increases from 5 to 15 volts which causes Q14 and CR10 to cutoff, removing the first digit tone from the output. Base bias resistor R32 and R37 are connected to 15-volt buss to prevent I_{CO} variations from causing Q12 and Q13 to conduct. When the digit button is released, 11 volts is removed from emitter Q12 and tone gate G1 cannot operate while the timing circuit recovers.

g. Tone Gate G2

- (1) The circuit of tone gate G2 is composed of transistors Q15, Q16, Q17, and Q18 and associated resistors. The collector of Q8 is also connected to the base resistor R41 of Q15. After 120 milliseconds, when time delay capacitor C9 has discharged sufficiently to allow Q8 to conduct, the collector voltage of Q8 rises to 11 volts which cuts Q15. The collector voltage of Q15 decreases from 11 volts to 1 volt, which causes Q16 to conduct. The emitter of Q16 is connected to the collector of Q11 forming an AND gate. Normally Q11 is conducting so when Q16 conducts, the collector voltage of Q16 increases to 11 volts causing Q17 to conduct. The collector of Q17 is connected to the base resistor R57 of Q18 and to diode CR12 of the diode OR gate. When Q17 conducts, its collector voltage decreases from 13.8 to 4.2 volts which causes Q18 and CR12 to conduct. Conduction of Q18 connects whichever capacitor the digit button has connected to line G2, to the oscillator, decreasing its frequency to the correct value for the second digit tone. Conduction of CR12 operates the output gate allowing the second digit tone to appear at the output.
- (2) After 300 milliseconds, the time delay capacitor C10 has discharged sufficiently to allow Q10 to conduct, which causes Q11 to be cut off. Since the collector of Q11 is connected to Q16, the collector voltage of Q16 decreases from 11 to 0.1 volt, which cuts off Q17. The collector voltage of Q17 increases from 4.2 to 13.8 volts cutting off Q18 and CR12 removing the second digit tone from the output.

h. Seize Tone Timing Circuit

- (1) Pressing the transmitter ON button operates relay K5, which supplies 11 volts to base resistor R53 of Q19 and the emitter of Q21, causing Q21 to conduct. The collector voltage of Q21 increases from .05 to 11 volts,



Subscriber Control Head,
Frontal View

collector voltage increases from 2 to 11 volts and is applied to base resistor R31 of Q12. This cuts off Q12 causing collector voltage of Q12 to decrease from 11 to 0.1 volts which cuts off Q13. The collector voltage of Q13 increases from 5 to 15 volts which causes Q14 and CR10 to cutoff, removing the first digit tone from the output. Base bias resistor R32 and R37 are connected to 15-volt buss to prevent I_{CO} variations from causing Q12 and Q13 to conduct. When the digit button is released, 11 volts is removed from emitter Q12 and tone gate G1 cannot operate while the timing circuit recovers.

g. Tone Gate G2

- (1) The circuit of tone gate G2 is composed of transistors Q15, Q16, Q17, and Q18 and associated resistors. The collector of Q8 is also connected to the base resistor R41 of Q15. After 120 milliseconds, when time delay capacitor C9 has discharged sufficiently to allow Q8 to conduct, the collector voltage of Q8 rises to 11 volts which cuts Q15. The collector voltage of Q15 decreases from 11 volts to 1 volt, which causes Q16 to conduct. The emitter of Q16 is connected to the collector of Q11 forming an AND gate. Normally Q11 is conducting so when Q16 conducts, the collector voltage of Q16 increases to 11 volts causing Q17 to conduct. The collector of Q17 is connected to the base resistor R57 of Q18 and to diode CR12 of the diode OR gate. When Q17 conducts, its collector voltage decreases from 13.8 to 4.2 volts which causes Q18 and CR12 to conduct. Conduction of Q18 connects whichever capacitor the digit button has connected to line G2, to the oscillator, decreasing its frequency to the correct value for the second digit tone. Conduction of CR12 operates the output gate allowing the second digit tone to appear at the output.
- (2) After 300 milliseconds, the time delay capacitor C10 has discharged sufficiently to allow Q10 to conduct, which causes Q11 to be cut off. Since the collector of Q11 is connected to Q16, the collector voltage of Q16 decreases from 11 to 0.1 volt, which cuts off Q17. The collector voltage of Q17 increases from 4.2 to 13.8 volts cutting off Q18 and CR12 removing the second digit tone from the output.

h. Seize Tone Timing Circuit

- (1) Pressing the transmitter ON button operates relay K5, which supplies 11 volts to base resistor R53 of Q19 and the emitter of Q21, causing Q21 to conduct. The collector voltage of Q21 increases from .05 to 11 volts,

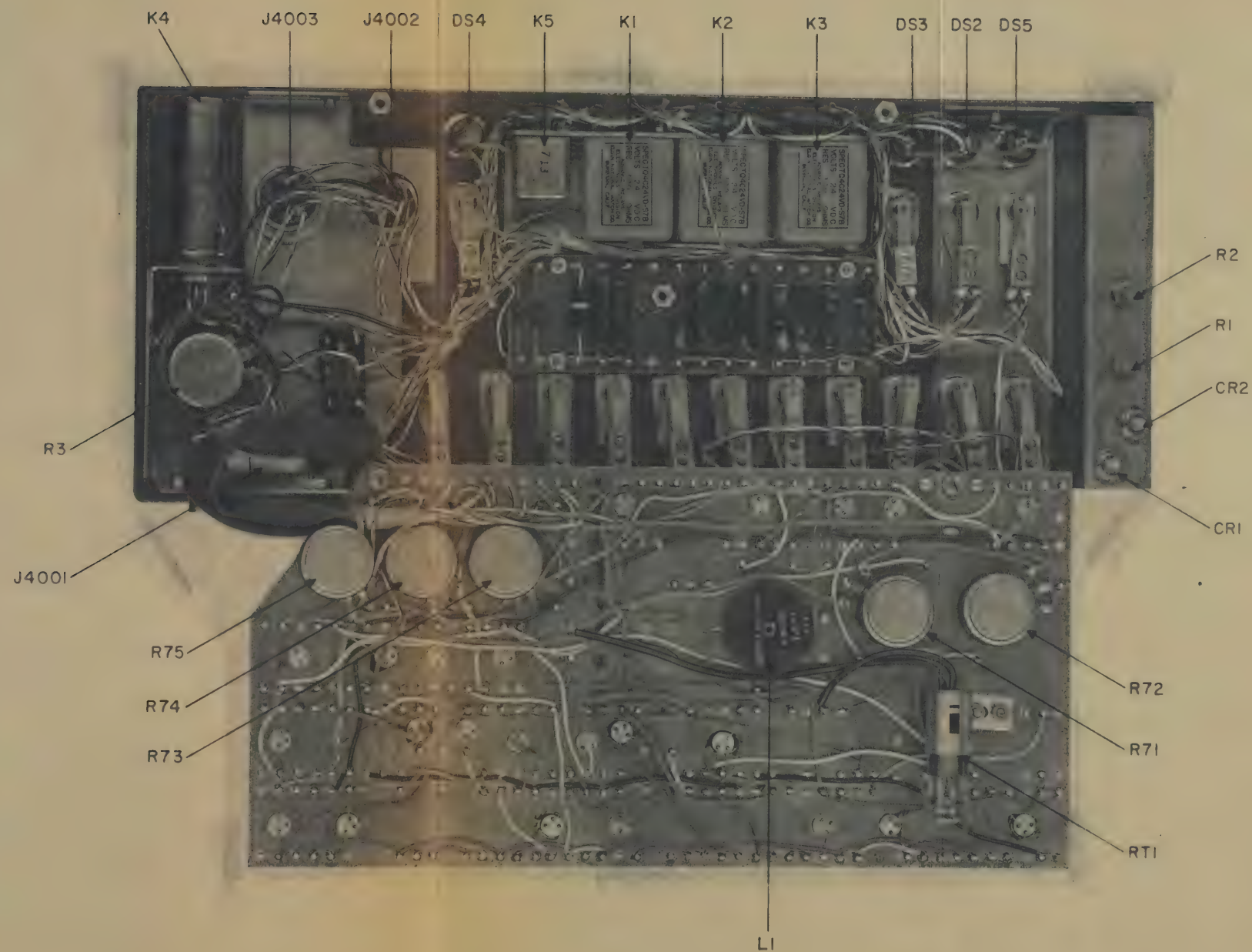


Figure 8. Subscriber Control Head,
Internal View

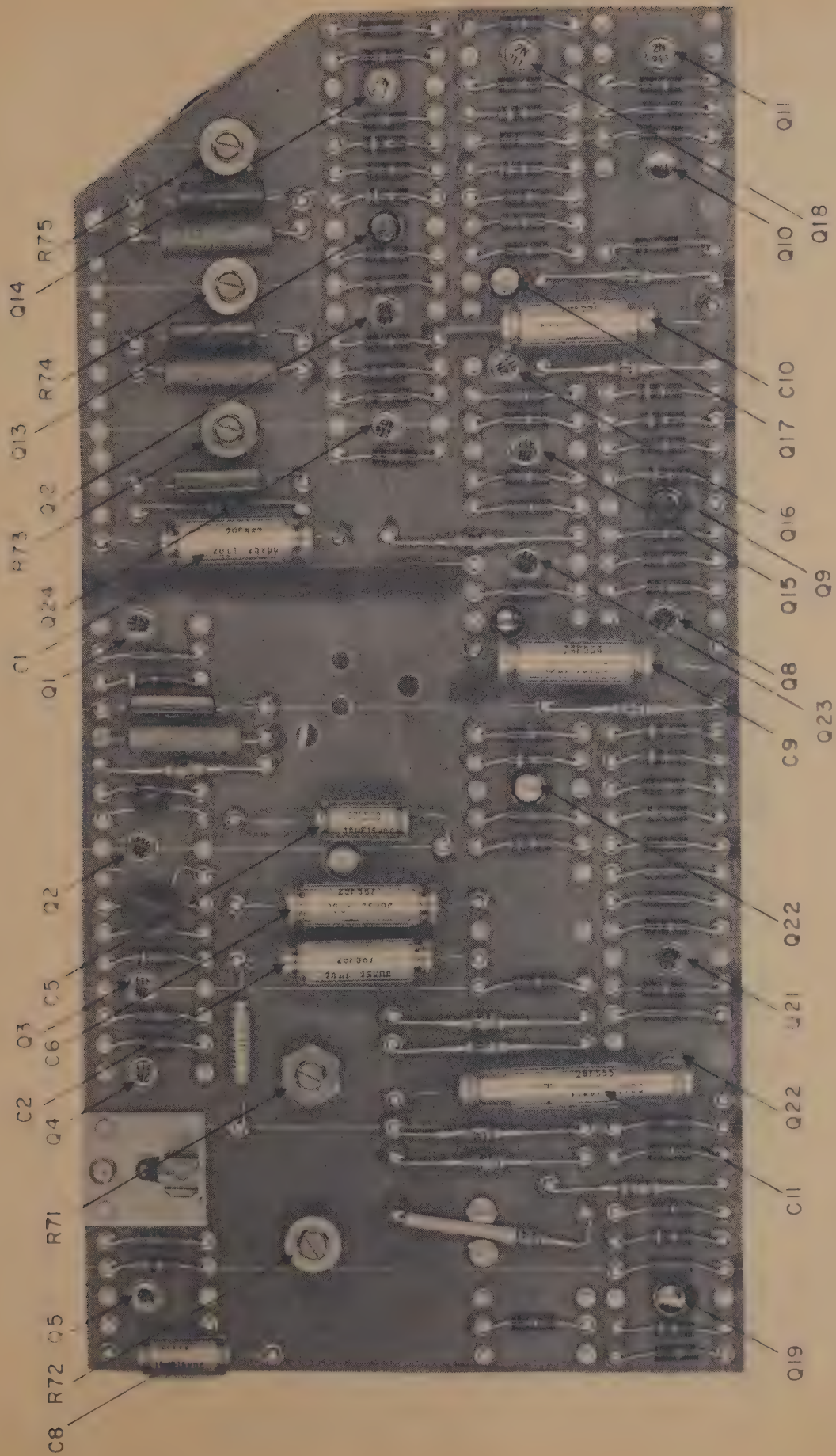


Figure 9. Subscriber Control Head, Component Board

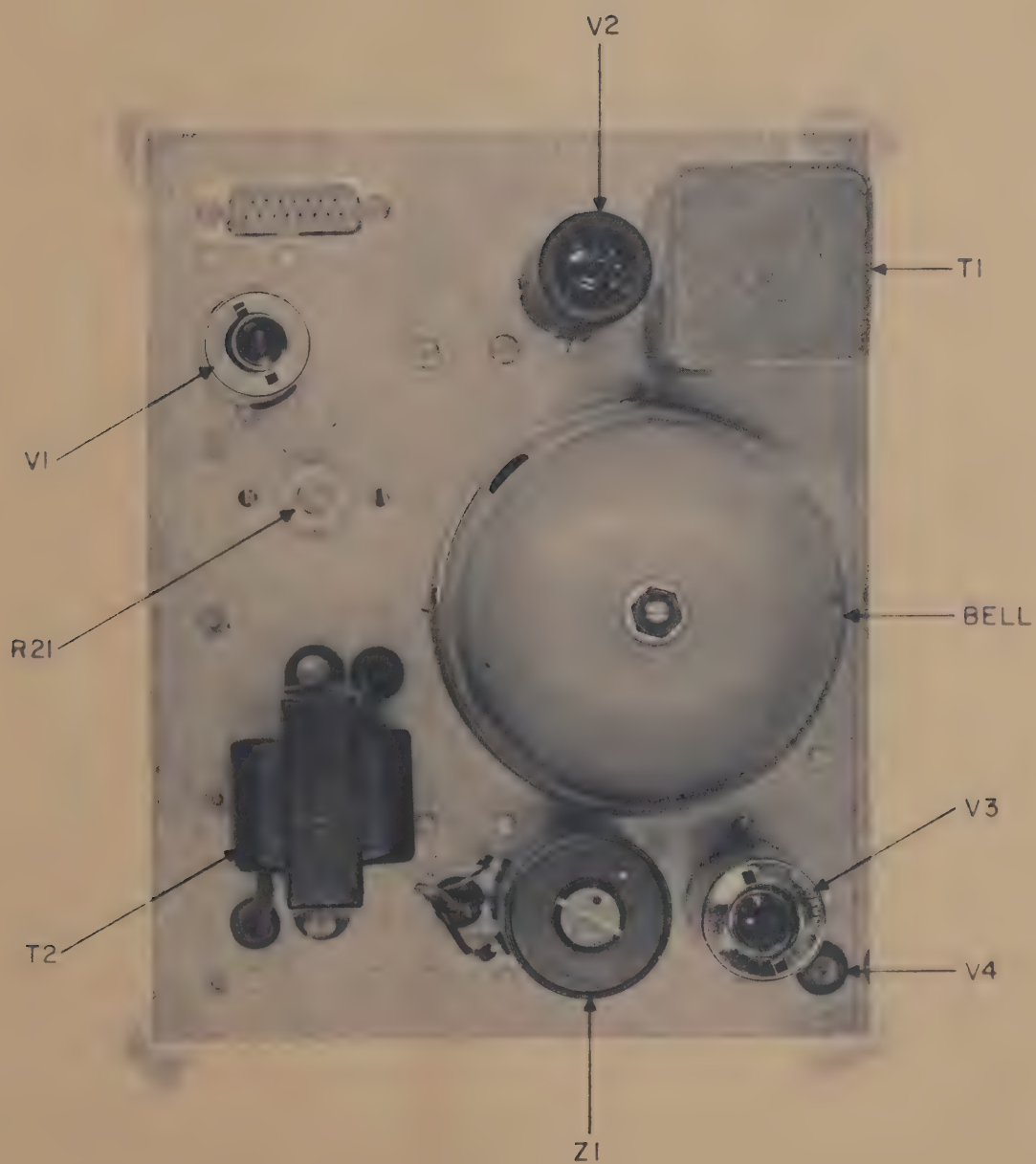


Figure 10. Subscriber Decoder And Audio Amplifier, Top View

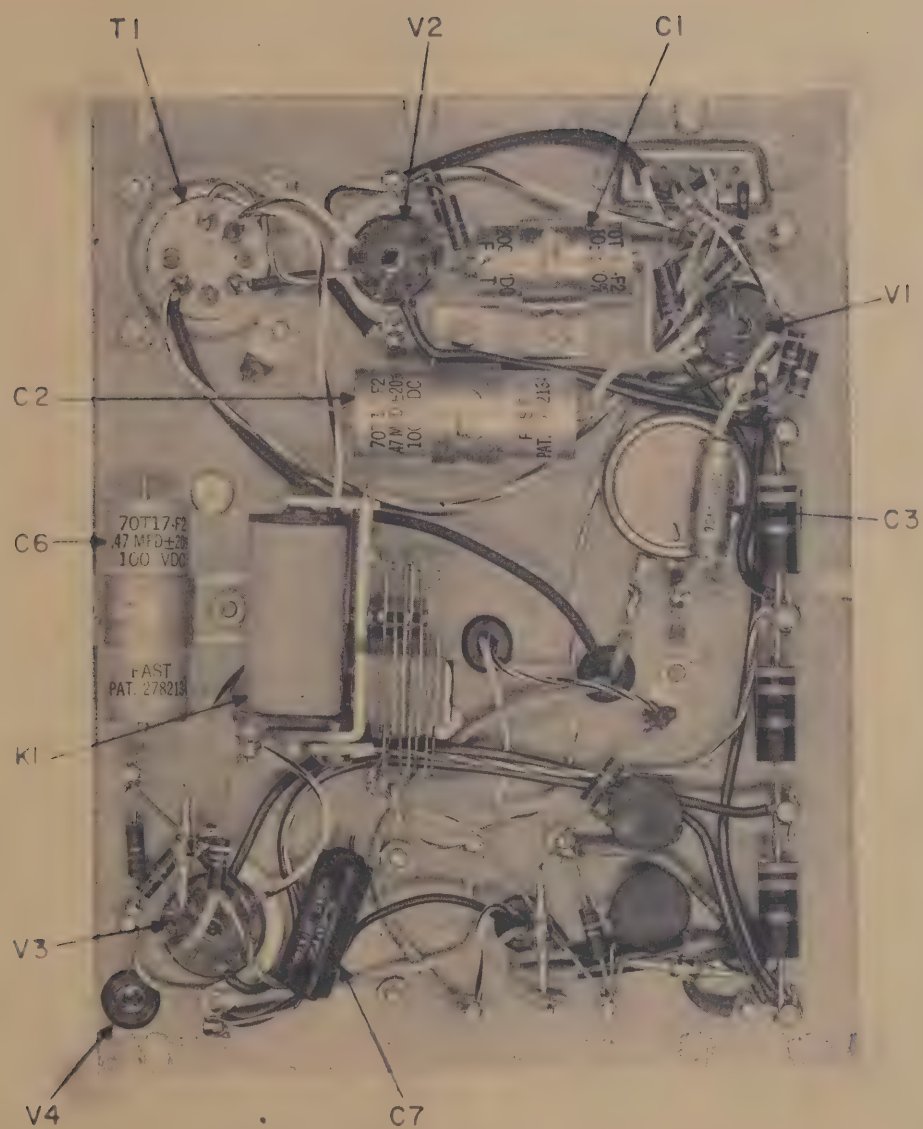


Figure II. Subscriber Decoder And Audio Amplifier ,
Bottom View

which causes Q22 to conduct. The collector of Q22 is connected to base resistor R69 of Q23 and CR11 of the diode OR gate. When Q22 conducts, its collector voltage decreases from 15 to 5 volts causing Q23 to conduct, which connects the capacitor to give the seize tone frequency across the oscillator tank circuit. This causes CR11 to conduct which in turn causes the output gate transistor Q4 to conduct.

- (2) The 11 volts applied to base resistor R55 of Q19 causes it to conduct causing its collector voltage to decrease from 15 to 3.3 volts. This decrease in voltage allows time delay capacitor C11 to discharge through time delay resistor R57. After one second, the voltage at CR9 has decreased sufficiently to allow base current of Q20 to follow, causing it to conduct and increase its collector voltage from 0.9 to 11 volts. The 11 volts at the collector is applied to base resistor R62 of Q21 causing it to cut off which reduces its collector voltage from 11 to 0.5 volts. This low collector voltage causes Q22 to cut off raising its collector voltage to 15 volts. In turn, the 15 volts causes Q23 and CR11 to be cut off removing the seize tone from the output.
- (3) The presence of CR8 across time delay resistor R57 reduces the charge time of time delay capacitor C11. Base bias resistors R61 and R64, which are connected to the 15-volt source, prevent variations in I_{CO} from causing Q20 and Q21 to conduct.

21. SUBSCRIBER DECODER CHASSIS

The Subscriber Decoder chassis (figures 10 and 11) consists of a two-stage audio amplifier and a decoder circuit which operate a signaling bell. The audio output impedance is 8 ohms when connected to the Subscriber Control Head. A schematic diagram of the Subscriber Decoder chassis is shown in figure 34. The operation of the decoder circuit is as follows:

- a. An input signal is fed to the center tap of transformer T1; the current through the transformer is split, part going through the 500-ohm balance pot and the other part through the series-tuned circuit. With on frequency signals, the resistance of the 500-ohm pot is adjusted so that it is equal to the series-resonant impedance of the tuned circuit. The currents flowing in the primary of T1 are equal and opposite in phase so no voltage is induced in the secondary. A high voltage is developed at the junction of the capacitor and inductance of the tuned circuit and is rectified giving a negative output voltage which is applied to the grid of the 6201 cutting it off. The plate voltage rises firing NE-2. The 0.47-microfarad capacitor is charged through the 1.5-megohm resistor and causes the second half of the 6201 to conduct, closing the relay, which rings the alarm bell.

b. For off-frequency signals, the series-resonant impedance of the tuned circuit rises and unbalanced signal currents flow in the primary of T1 inducing a voltage in the secondary. This voltage is rectified, giving a positive output, which is applied to the grid of the 6201 driving it further into conduction.

c. The presence of NE-2 prevents the time delay circuit R13, C6, and CR3 from operating on small voltage fluctuations. The time delay circuit with diode CR3 across resistor R12 decreases the sensitivity of the decoder to voice signals.

22. SUBSCRIBER NOISE BLANKER

The Subscriber Noise Blanker (figures 12 and 13) is of the "frequency reference" type which has been developed to produce a low amount of intermodulation. This method utilizes the higher frequency impulse noise components present at the receiver to produce the blanking pulse. These frequency components are removed by filtering at a point in the receiver where they are no longer needed so that steady-state signals in the blanker produce little effect. About 35-db of blanking has been achieved with the Subscriber Noise Blanker. Figure 35 is the schematic diagram of the noise blanker.

23. CENTRAL STATION TRANSLATION EQUIPMENT

a. The Central Station Translation Equipment provides the facilities for translation the "two-out-of-four" sequential tone method of dialing as received from a Subscriber station to a "two-out-of-five" compound tone method of dialing required by the automatic switchboard.

b. The operation of the Translation Equipment is shown in the operational diagram single channel of figure 36. There are eight voice channels at the Central Station. Each channel is equipped with the items shown in the operational block diagram. All of the equipment required at the Central Station, along with the schematic diagrams of each item are discussed in the remaining pages of this chapter of the instruction book.

The following diagrams are Translation Equipment system block, interconnection, and cabling diagrams.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
36.	Radio Central Automatic-Dialing Translation Equipment, Operational Block Diagram (Single Channel)	103/104
37	Interconnecting Diagram, Intra Cabinet Signal Radio Central Equipment Translation Equipment	105/106



Figure 12. Subscriber Noise Blanker Chassis, Top View

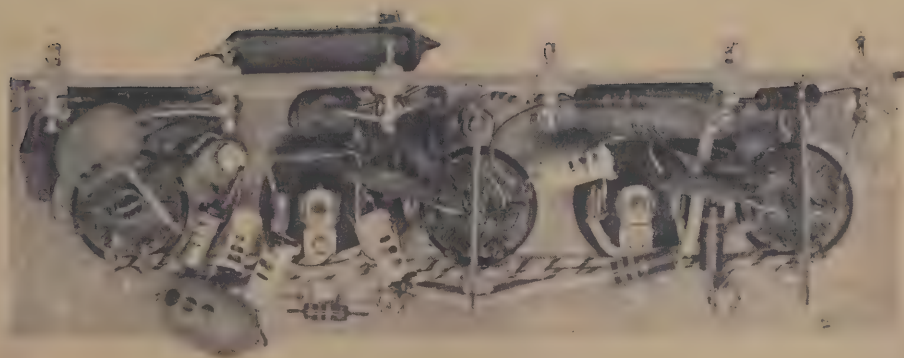


Figure 13. Noise Blanker Chassis, Bottom View

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
38.	Translation Equipment Intracabinet Cabling Diagram (Power)	107/108
39	Translation Equipment Intracabinet Cabling Diagram (Signaling)	109/110

24. RECEIVER AND SSB GENERATOR AUDIO AMPLIFIER CABINET

In order to obtain a sufficient audio level and the proper impedance value for the SSB generators, and for the sequential tone decoders in the Central station, each receiver and transmitter channel has been provided with an audio amplifier (figure 14). The schematic diagram of these amplifiers is shown in figure 40. See Chapter 4, paragraph 35 for the adjustments required for proper operation of the audio amplifier and radio Central equipment. Refer to the following drawings for additional data.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
40	Receiver And SSB Audio Amplifier Schematic Diagram	111/112
41	Receiver And SSB Generator Audio Ampli- fier Cabinet, Cabling Diagram	113/114

25. CENTRAL STATION DECODER CHASSIS

The Central station Decoder chassis occupy two drawers in the Translation Equipment rack. Each drawer contains the decoder circuits for four channels. Each channel utilizes four decoder circuits. These circuits are tuned to 800, 1000, 1200 and 1400 cycles per second. The operation of the decoders is the same as described for the Subscriber station Decoder chassis. In order to receive the seize tone of 800 cps and the release tone of 1000 cps, a second time delay circuit is added to these two tone decoder circuits. The time delay circuit of R7, CR4, C5, VR2, and V2A makes it possible to use the 800-cycle decoder as the seize function. A 500-millisecond tone is required to operate the seize tone trigger circuit. The time delay circuit consisting of R21, CR8, C11, VR4, and V2B makes it possible to use the 1000-cycle decoder as the release function. A 500-millisecond tone is required to operate the release tone trigger circuit. The sequential digit tones are sent for approximately 150 milliseconds duration for each tone. The Decoder chassis output pulses and voice circuits are fed into the Dial and Line Translator circuits. The Decoder chassis is shown in figures 15, 16, and 17. Figure 42 is the schematic diagram of the Decoder chassis.

26. DIAL TRANSLATOR, THEORY OF OPERATION

The primary function of the Dial Translator (figure 18) is to transform sequential dialing tones to the Stromberg equivalent of compound tones. These tones correspond to digits one through zero and a recall, seize, and release function. The schematic and intrachassis cabling diagrams are shown in figures 43 and 44.

a. Transformation From Sequential To Compound Tones.

- (1) The input to the Dial Translator is triggered by the output of the Decoder which provides d-c pulses from the sequential tones. A pair of sequential pulses corresponding to a particular digit will produce conditioning pulses on a group of AND gates. One conditioning pulse will be for a duration of 300 milliseconds while the other will be for the duration of the Decoder trigger pulse. Since each tone of the sequential combination is approximately 150 milliseconds, the 300-millisecond conditioning pulse will provide coincidence time to take place at its center.
- (2) The output of the AND gate drives a modified monostable multivibrator in that its pulse width will be as long as the pulse from the AND gate, but no shorter than the natural time of the circuit (100 milliseconds). The output pulse of the MSMV triggers its tone gate releasing compound tones (corresponding to the digit involved) into the Line Translator. The seize and release functions are not dependent on a sequential combination of tones, therefore AND gates are not required. These functions trigger their respective MSMV which in turn triggers its tone gate, releasing the Stromberg equivalent of these two functions.

b. Digit Acknowledgement and Translator Blanking. The output of each digit MSMV is combined to form an acknowledgement buss, which provides a trigger pulse to the acknowledgement gate in the Line Translator, and a trigger pulse to the blanking gate of the Dial Translator. The blanking gate interrupts the Central receiver input for a duration of 300 milliseconds starting with the time the compound tones are being released. Separate release and seize d-c functions are taken from their respective MSMV to provide release and seize functions on the Line Translator. The digital and signaling tones handled by the Dial Translators are shown in Table II.

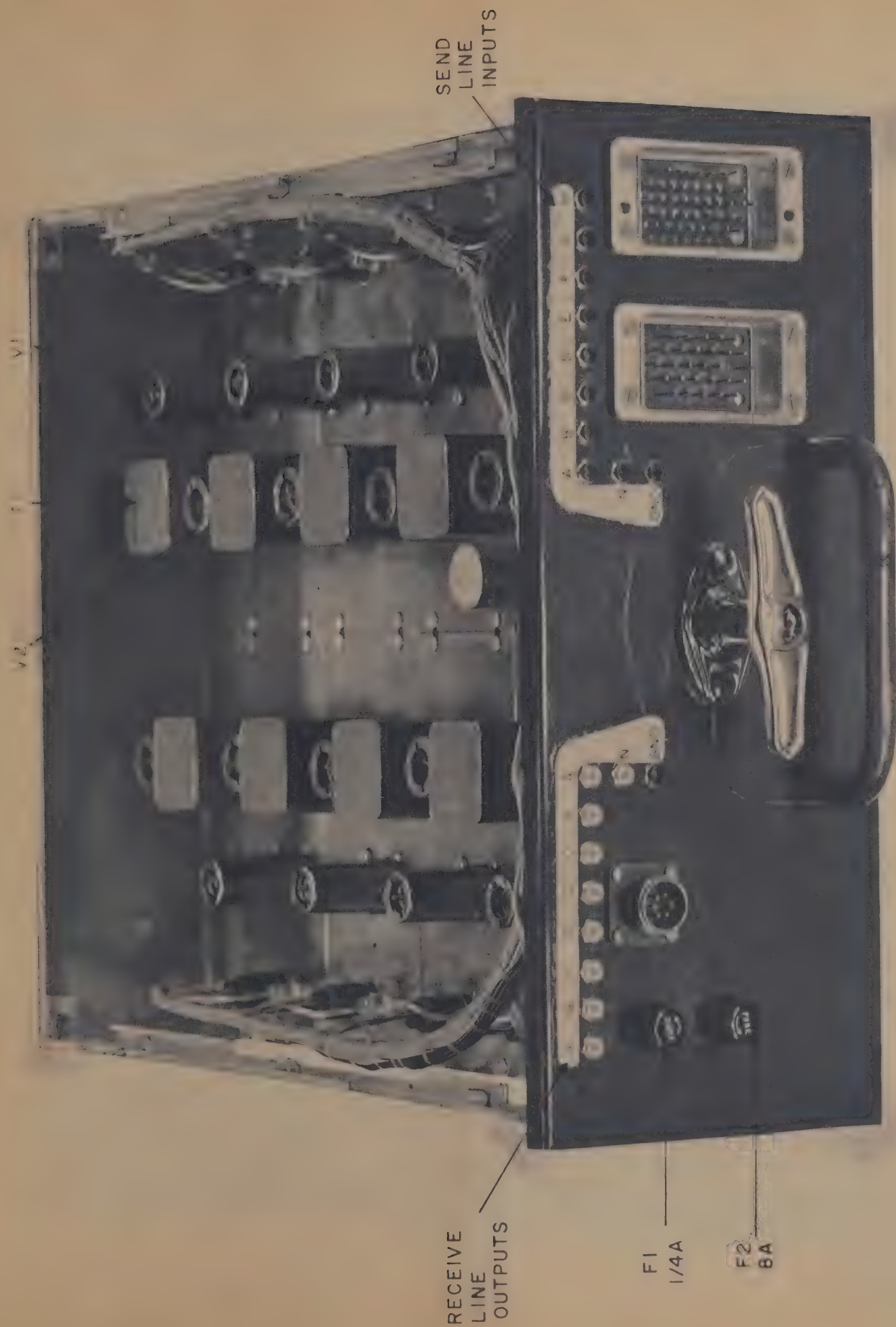


Figure 14. Receiver And SSB Audio Amplifier Cabinet

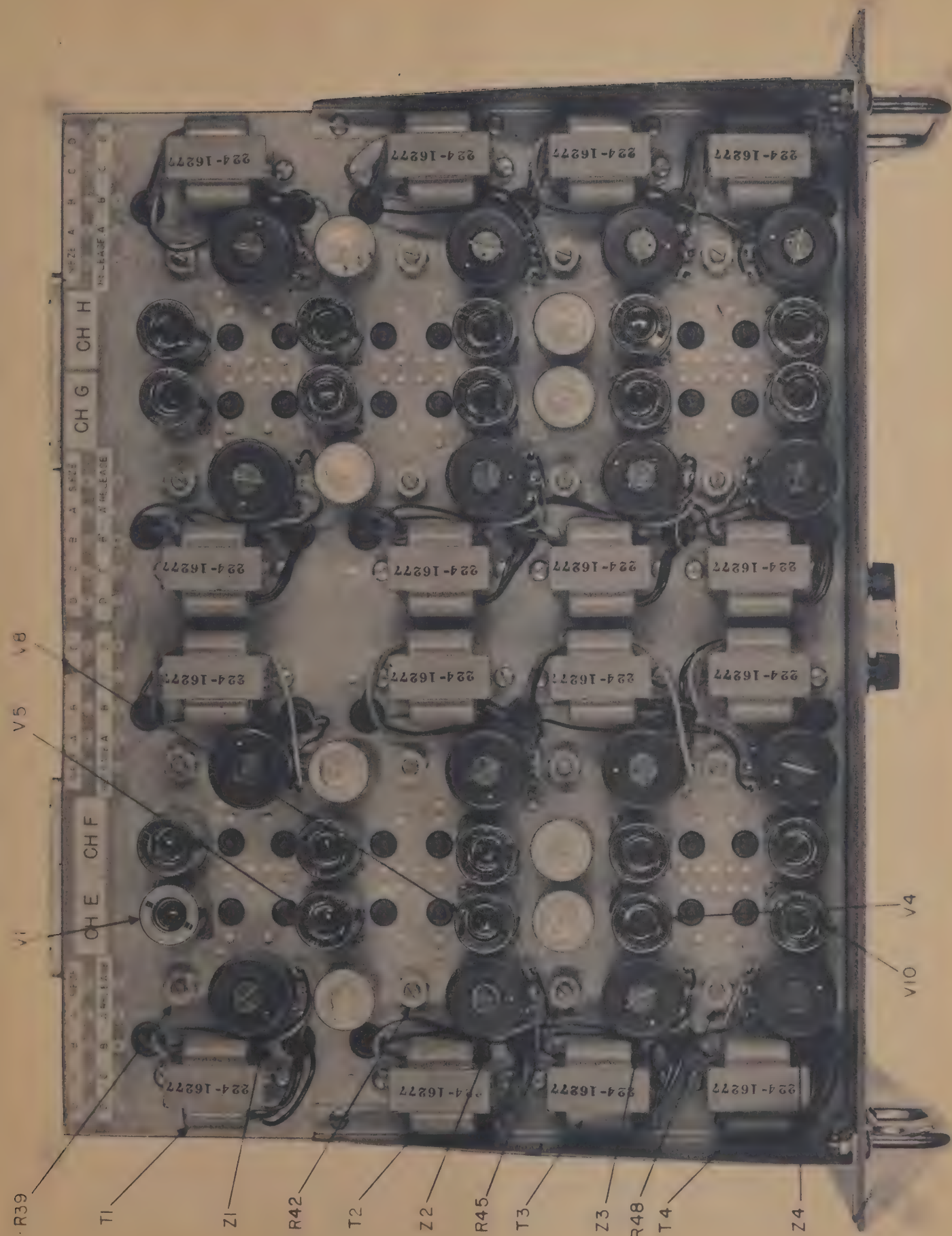
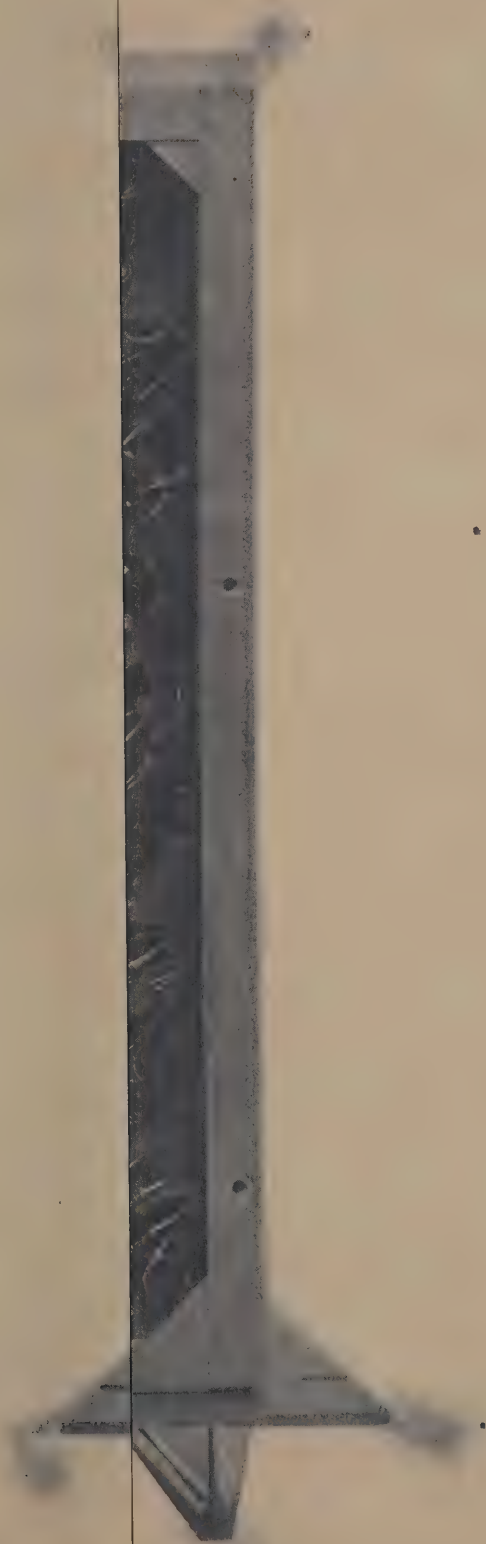


Figure 15. Central Station Decoder Chassis, Top View



6. Central Station Decoder
Chassis, Bottom View

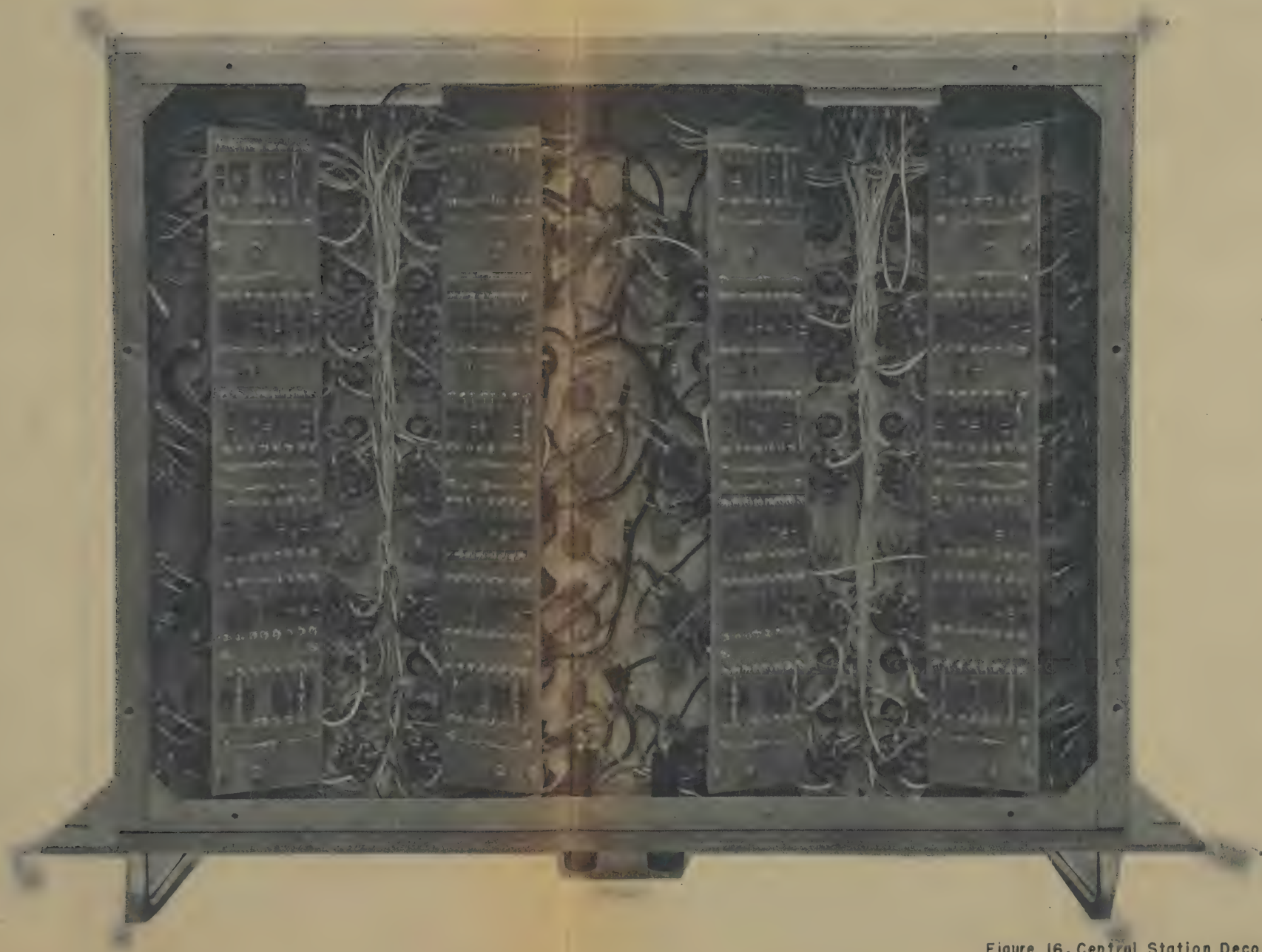


Figure 16. Central Station Decoder
Chassis, Bottom View

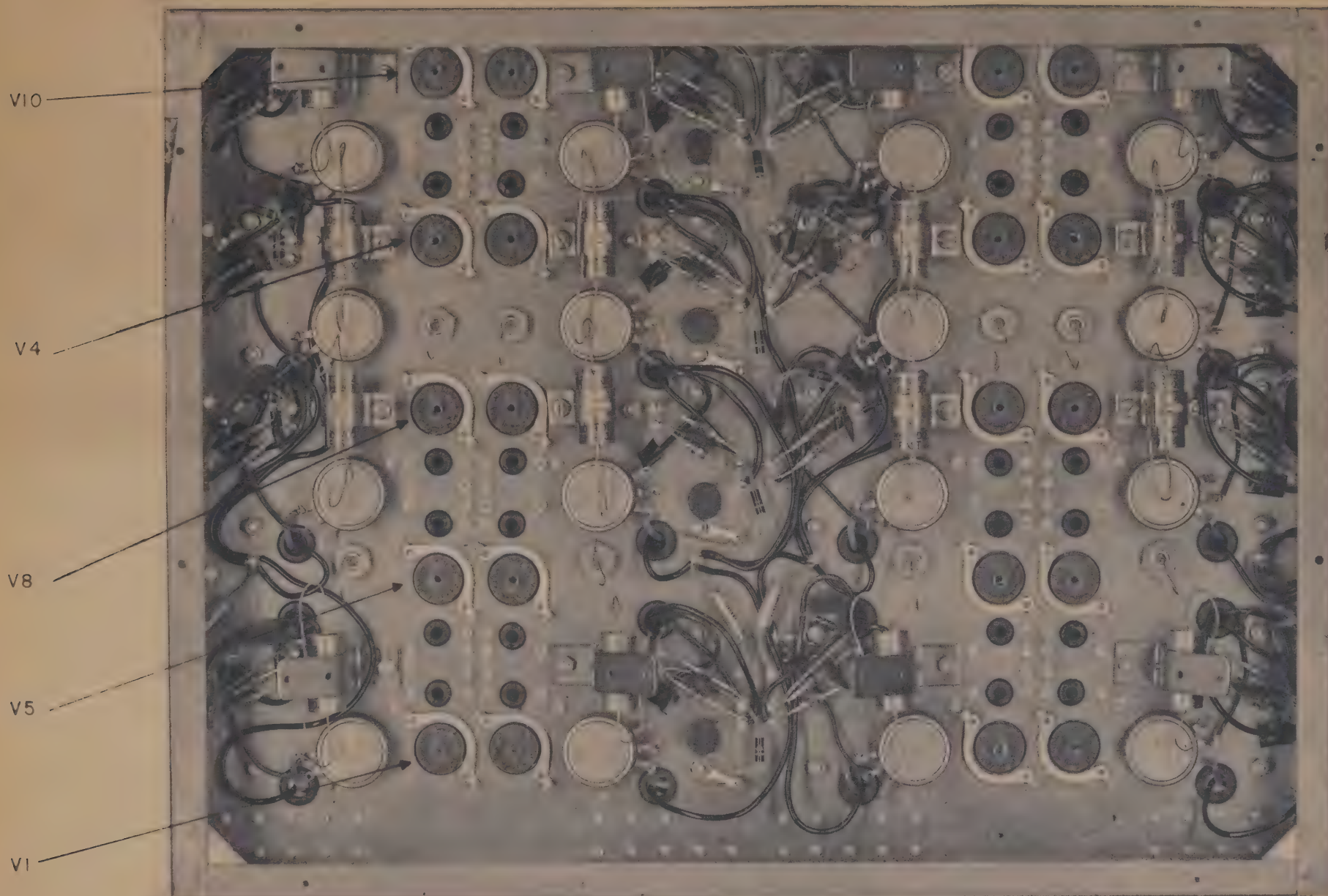


Figure 17. Central Station Decoder Chassis, Bottom View,
Without Terminal Boards

TABLE II
DIGITAL AND SIGNALING TONES

<u>Subscriber Station Signaling Tones</u>		<u>Automatic Switchboard Signaling Tones</u>
A.	1400 cps	S. 1700 cps
B.	1200	U. 1900
C.	1000	V. 2100
D.	800	W. 2300
		X. 2500
		Y. 2700
		Z. 2900

<u>Sequential Tones</u>	<u>Digit/Function</u>	<u>Compound Tones</u>
BA	1	VW
CA	2	XW
DA	3	UY
AB	4	UV
CB	5	XY
DB	6	WY
AC	7	VX
BC	8	UW
DC	9	VY
AD	0	UX
D	Seize	S
C	Release	YZ
BD	Recall	WZ

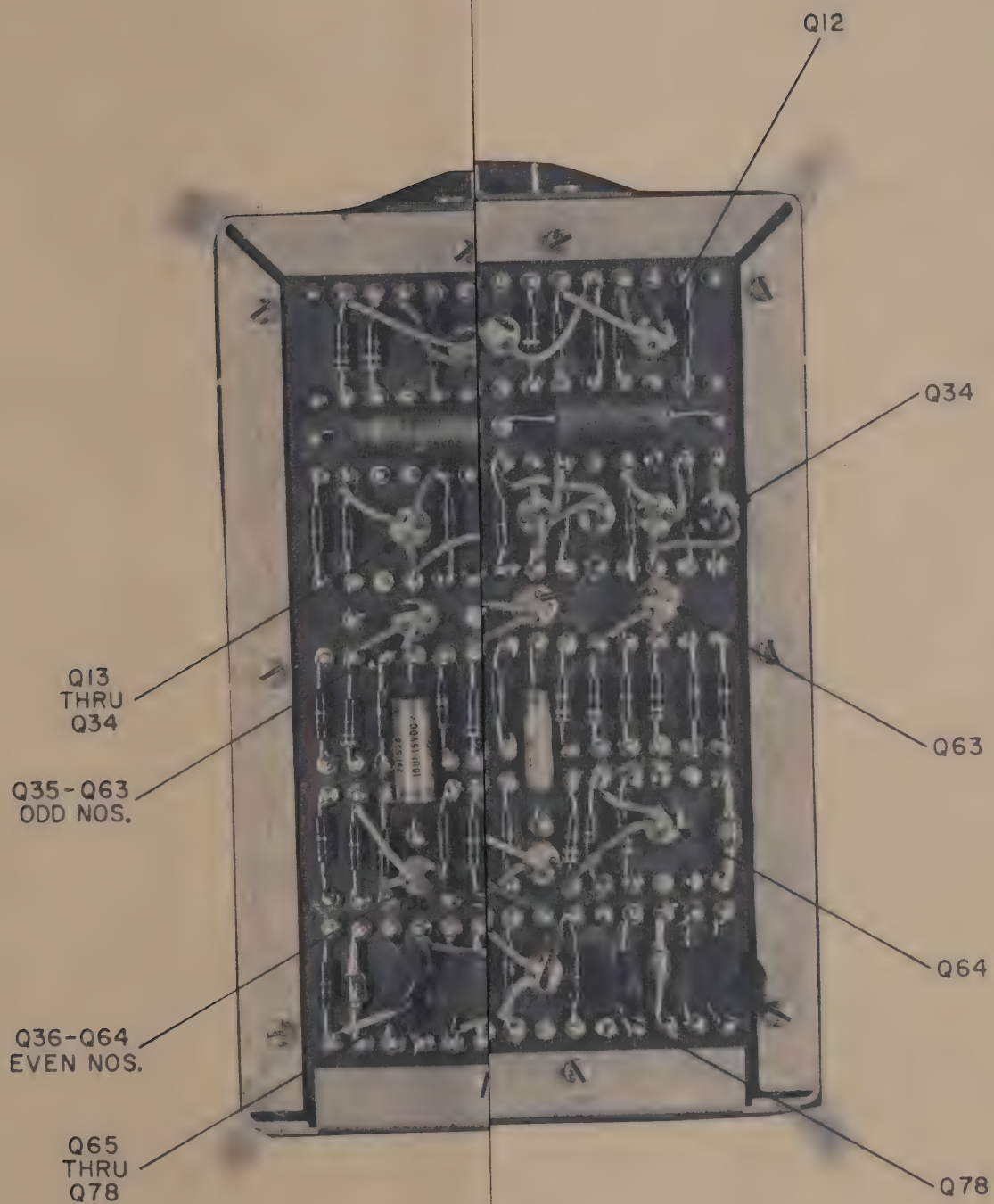
27. LINE TRANSLATOR

The Line Translator unit provides two party line facilities between the radio Central station and the automatic switchboard. The basic requirement for this equipment is to connect the automatic switchboard terminals to the Central receiver radio-frequency channels and the SSB transmitter channels. All Subscribers, except the one which has completed a connection to and from the switchboard via the radio Central system, must be kept out of the channel in use and these subscribers must be provided with a busy tone to indicate to them that the channel is in use. The compound tones, used for digit, seize, release, and recall functions, and controlled in the Dial Translator chassis, are connected to the automatic switchboard by means of the Line Translator chassis. Each of the eight r-f voice channels is equipped with a Line Translator plug-in unit as shown in figures 19 and 20. The Line Translators are contained in one drawer of the translation equipment rack. Figures 45 and 46 are the Line Translator schematic and intrachassis cabling diagrams.

a. General Functions. The functions of the Line Translator are as follows:

- (1) provide a two-party line for each r-f channel,
- (2) provide a primary channel for incoming calls (calls from the Subscriber),
- (3) provide selective calling to either Subscriber,
- (4) on outgoing calls (calls from the switchboard) provide busy tone to the proper line when communication between Subscribers has been established,
- (5) on incoming calls (calls from the Subscriber) provide busy tone to the proper line as soon as the call is initiated,
- (6) provide an acknowledgment signal to assure the Subscriber that his dial signals have been transformed to compound tones, and
- (7) prevents a call on line 2 from taking control of the party line prior to Subscriber #1 responding to its call.

b. Translator Operation (Outgoing calls on Line 1). Calls are initiated at the Central by a 600-cycle tone applied manually from the Central tester through the patching network of the tester switchboard. This signal passes through gate Q8 and into the 600-cycle amplifier and pulse amplifier. The pulse amplifier output opens ringing tone gate Q4 allowing the ringing tone for Subscriber #1 (1000 cycles) to pass to the output of the Line Translator. Along with this operation, Line 1 control BSMV (Q12 and



Translator, Single Channel
Components Board

27. LINE TRANSLATOR

The Line Translator unit provides two party line facilities between the radio Central station and the automatic switchboard. The basic requirement for this equipment is to connect the automatic switchboard terminals to the Central receiver radio-frequency channels and the SSB transmitter channels. All Subscribers, except the one which has completed a connection to and from the switchboard via the radio Central system, must be kept out of the channel in use and these subscribers must be provided with a busy tone to indicate to them that the channel is in use. The compound tones, used for digit, seize, release, and recall functions, and controlled in the Dial Translator chassis, are connected to the automatic switchboard by means of the Line Translator chassis. Each of the eight r-f voice channels is equipped with a Line Translator plug-in unit as shown in figures 19 and 20. The Line Translators are contained in one drawer of the translation equipment rack. Figures 45 and 46 are the Line Translator schematic and intrachassis cabling diagrams.

a. General Functions. The functions of the Line Translator are as follows:

- (1) provide a two-party line for each r-f channel,
- (2) provide a primary channel for incoming calls (calls from the Subscriber),
- (3) provide selective calling to either Subscriber,
- (4) on outgoing calls (calls from the switchboard) provide busy tone to the proper line when communication between Subscribers has been established,
- (5) on incoming calls (calls from the Subscriber) provide busy tone to the proper line as soon as the call is initiated,
- (6) provide an acknowledgment signal to assure the Subscriber that his dial signals have been transformed to compound tones, and
- (7) prevents a call on line 2 from taking control of the party line prior to Subscriber #1 responding to its call.

b. Translator Operation (Outgoing calls on Line 1). Calls are initiated at the Central by a 600-cycle tone applied manually from the Central tester through the patching network of the tester switchboard. This signal passes through gate Q8 and into the 600-cycle amplifier and pulse amplifier. The pulse amplifier output opens ringing tone gate Q4 allowing the ringing tone for Subscriber #1 (1000 cycles) to pass to the output of the Line Translator. Along with this operation, Line 1 control BSMV (Q12 and

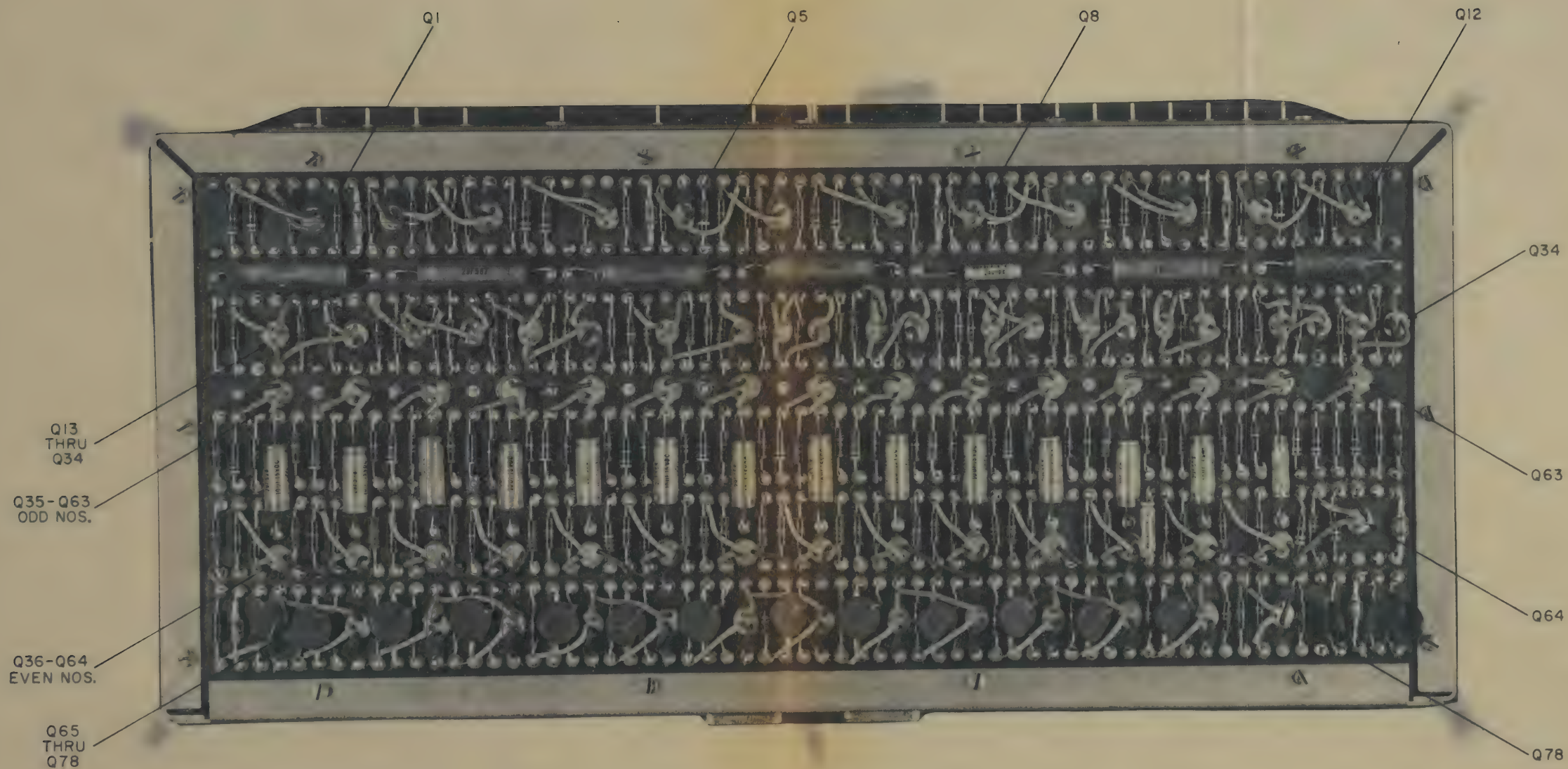


Figure 18. Dial Translator, Single Channel
Components Board



Line Translator (Single Channel)
Components Board, Front View

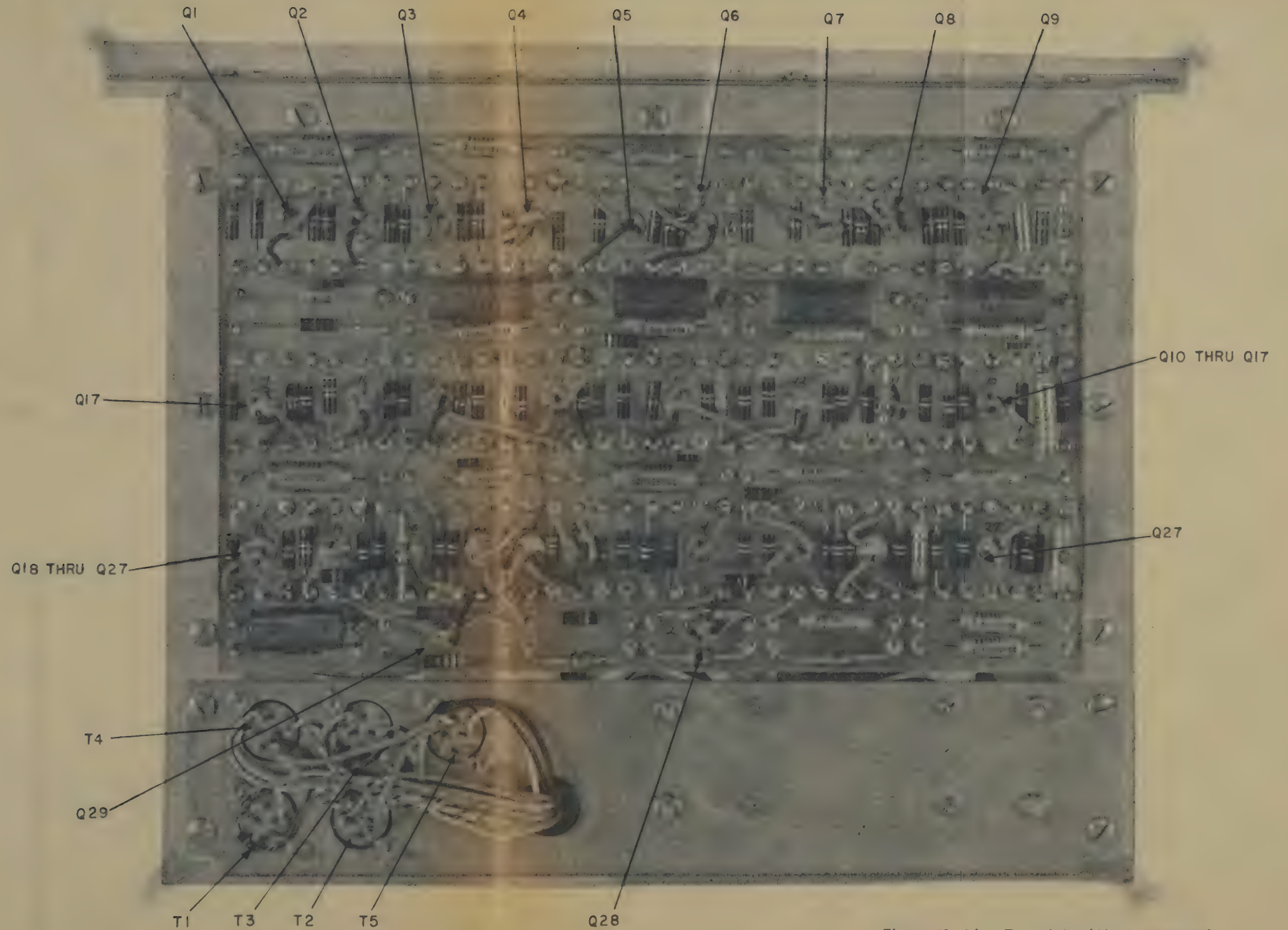


Figure 19. Line Translator (Single Channel)
Components Board, Front View



Motor (Single Channel)
s Board, Back View

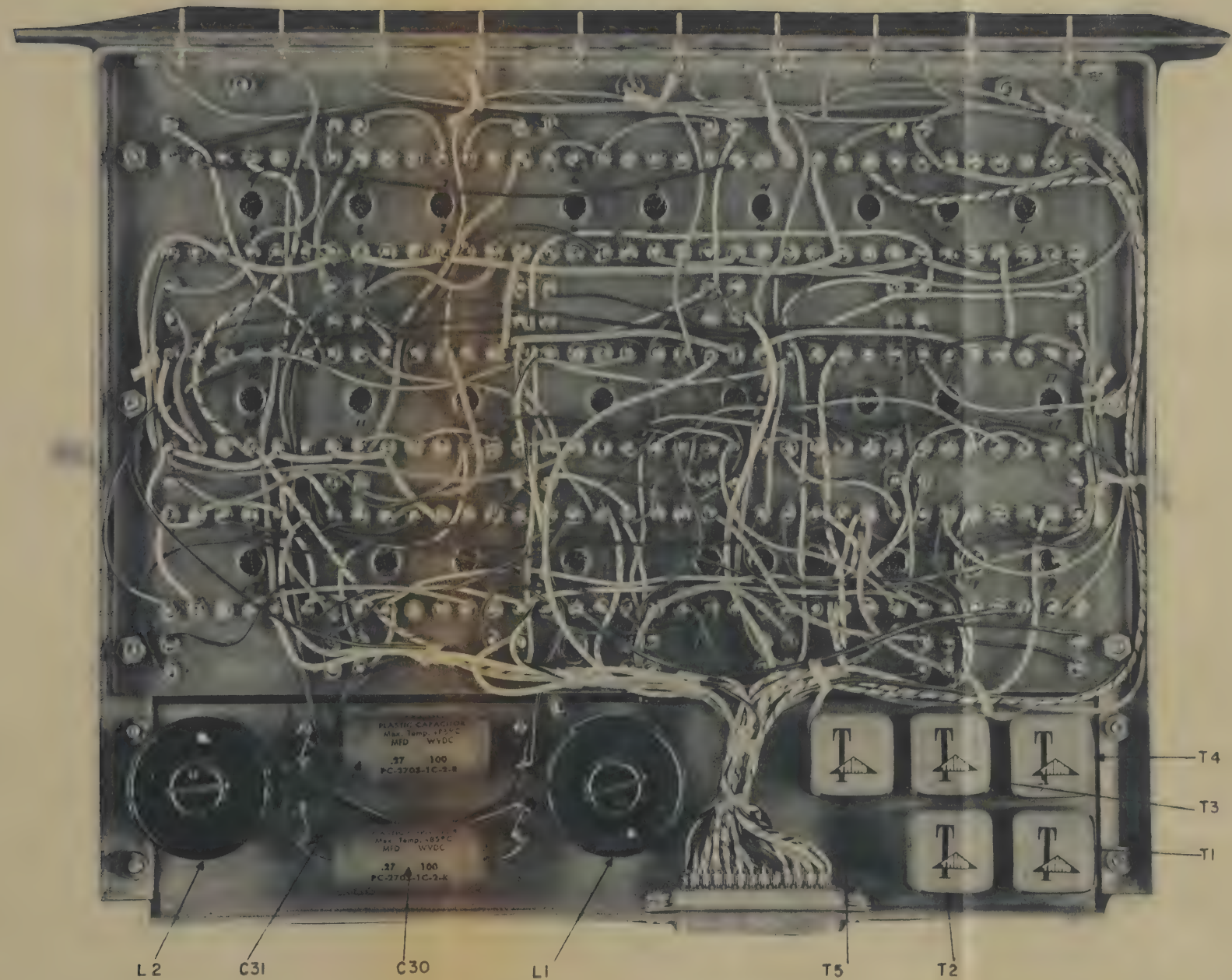


Figure 20. Line Translator (Single Channel)
Components Board, Back View

Q13) is triggered which prevents any interruption to take place should a call originate on Line #2. This is done by having this BSMV close G3, which will prevent Line 2 control BSMV (Q16-17) from being triggered. The Subscriber, responding to his call, transmits a seize tone which produces a seize pulse at the Line Translator. This triggers the seize control BSMV (Q14-15) and the following take place:

- (1) Gate Q11 is opened providing a voice path to the translator output.
- (2) Signaling gate Q8 is closed preventing false ringing to take place during periods of conversation.
- (3) Busy tone control gate Q29 is opened allowing 600-cycle busy tone to appear at the receive terminals of Line #2.

In completing the call, a release tone is transmitted by the Subscriber producing a release pulse at the Line Translator. This triggers the seize control BSMV (Q14-15) and the line control BSMV (Q12-13) setting them back to their original condition.

c. Translator Operation (Outgoing Calls on Line #2). Calls are initiated in the same manner as those for line #1, however, control is achieved on the trailing edge of the 600-cycle ring-tone. This trailing edge triggers line #2 control flip-flop (Q16-17) through G3 and the following events take place.

- (1) Gates Q9 and Q10 are closed prohibiting any of the received signals to be heard at line #1 or any send signals on line #1 from appearing on the party line.
- (2) Gate Q18 is opened allowing the busy tone to appear at its output. However, this output is clamped to ground through Q28. This clamping action is removed as soon as the Subscriber responds to his call with a seize tone.
- (3) Gate Q19 is closed prohibiting the busy tone from appearing on line #2.
- (4) Gates Q20 and Q27 are opened. Gate Q20 allows line #2 ringing tone to appear at the translator output. Gate Q27 closes the receive path to line two. With the opening of Gate Q20 on the trailing edge of the 600-cycle call tone, line #2 ringing tone will not be present until the second call tone has been initiated.
- (5) The Subscriber's seize pulse will trigger the seize control flip-flop (Q15-4) and close Gate Q26, completing the send circuit of line #2. Gate Q28 is also opened allowing busy tone to appear at line #2. The release

pulse resets all the BSMV placing the translator back to its standby condition.

The operation of G3 is such that once line #1 control BSMV has been triggered by a call on line #1, CR8 will not permit line #2 control BSMV to be triggered by a call on line #2. This permits use of the party line on a first-come-first-serve-basis. The acknowledgement tone is gated by a monostable multivibrator timed for 100 milliseconds. This MV is triggered from the acknowledgment pulse of the Dial Translator. Since the Stromberg release pulse is developed as soon as the Subscriber sends its release pulse, the translator is released on the trailing edge of the Subscriber release pulse, thus permitting the compound tones to pass through prior to the translator's release.

28. TONE GENERATOR

The signaling tones required by the automatic switchboard and the Subscriber stations are generated in the tone generator chassis (figures 21 and 22). The tone generator is contained in one drawer of the Translation Equipment rack. Figure 47 is the schematic diagram for the tone generator.

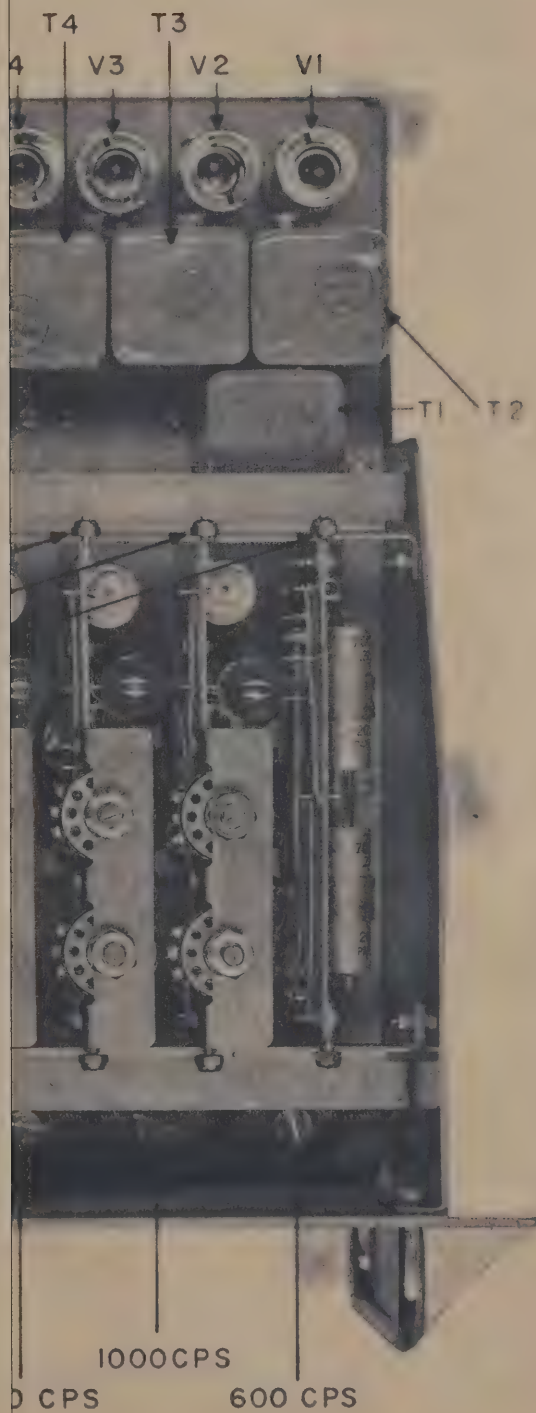
a. The high-frequency audio tones, which range from 1900 to 2900 cycles, are generated in transistor plug-in oscillators (figure 23) and then combined in vacuum tube combining circuits the outputs of which are connected to the Dial Translator chassis. These compound tones are the digits, release, and recall tones required by the automatic switchboard.

b. The 1700, 1200, 1000, and 600-cycle tones are also generated in transistor plug-in units (figure 23) utilizing a LC circuit to control the frequency. The amplitude of all of these oscillators is controlled by positive feedback through a 6-watt 115-volt tungsten filament lamp, the positive resistance versus voltage characteristics of which controls the oscillation amplitude for a given setting of feedback control P1. The 1700-cycle tone provides the seize tone for the automatic switchboard. The 600-cycle steady tone is used for ringing Subscriber stations when using the one-line manual switchboard. The actual ringing frequencies are provided by the 1000 and 1200-cycle tones but these are activated by the 600-cycle tone.

c. A 300-cycle transistor oscillator plug-in unit (figure 24) provides digit acknowledgment tones for the Subscriber stations. A half-second on half-second off multivibrator circuit contained on this same sub-chassis provides for the gating of the 600-cycle oscillator half-second on and half-second for the busy tone signal.

29. POWER SUPPLIES

a. High-Voltage Vacuum Tube Supply. The 200-volt plate supply



Generator, Tap View

pulse resets all the BSMV placing the translator back to its standby condition.

The operation of G3 is such that once line #1 control BSMV has been triggered by a call on line #1, CR8 will not permit line #2 control BSMV to be triggered by a call on line #2. This permits use of the party line on a first-come-first-serve-basis. The acknowledgement tone is gated by a monostable multivibrator timed for 100 milliseconds. This MV is triggered from the acknowledgment pulse of the Dial Translator. Since the Stromberg release pulse is developed as soon as the Subscriber sends its release pulse, the translator is released on the trailing edge of the Subscriber release pulse, thus permitting the compound tones to pass through prior to the translator's release.

28. TONE GENERATOR

The signaling tones required by the automatic switchboard and the Subscriber stations are generated in the tone generator chassis (figures 21 and 22). The tone generator is contained in one drawer of the Translation Equipment rack. Figure 47 is the schematic diagram for the tone generator.

a. The high-frequency audio tones, which range from 1900 to 2900 cycles, are generated in transistor plug-in oscillators (figure 23) and then combined in vacuum tube combining circuits the outputs of which are connected to the Dial Translator chassis. These compound tones are the digits, release, and recall tones required by the automatic switchboard.

b. The 1700, 1200, 1000, and 600-cycle tones are also generated in transistor plug-in units (figure 23) utilizing a LC circuit to control the frequency. The amplitude of all of these oscillators is controlled by positive feedback through a 6-watt 115-volt tungsten filament lamp, the positive resistance versus voltage characteristics of which controls the oscillation amplitude for a given setting of feedback control P1. The 1700-cycle tone provides the seize tone for the automatic switchboard. The 600-cycle steady tone is used for ringing Subscriber stations when using the one-line manual switchboard. The actual ringing frequencies are provided by the 1000 and 1200-cycle tones but these are activated by the 600-cycle tone.

c. A 300-cycle transistor oscillator plug-in unit (figure 24) provides digit acknowledgment tones for the Subscriber stations. A half-second on half-second off multivibrator circuit contained on this same sub-chassis provides for the gating of the 600-cycle oscillator half-second on and half-second for the busy tone signal.

29. POWER SUPPLIES

a. High-Voltage Vacuum Tube Supply. The 200-volt plate supply

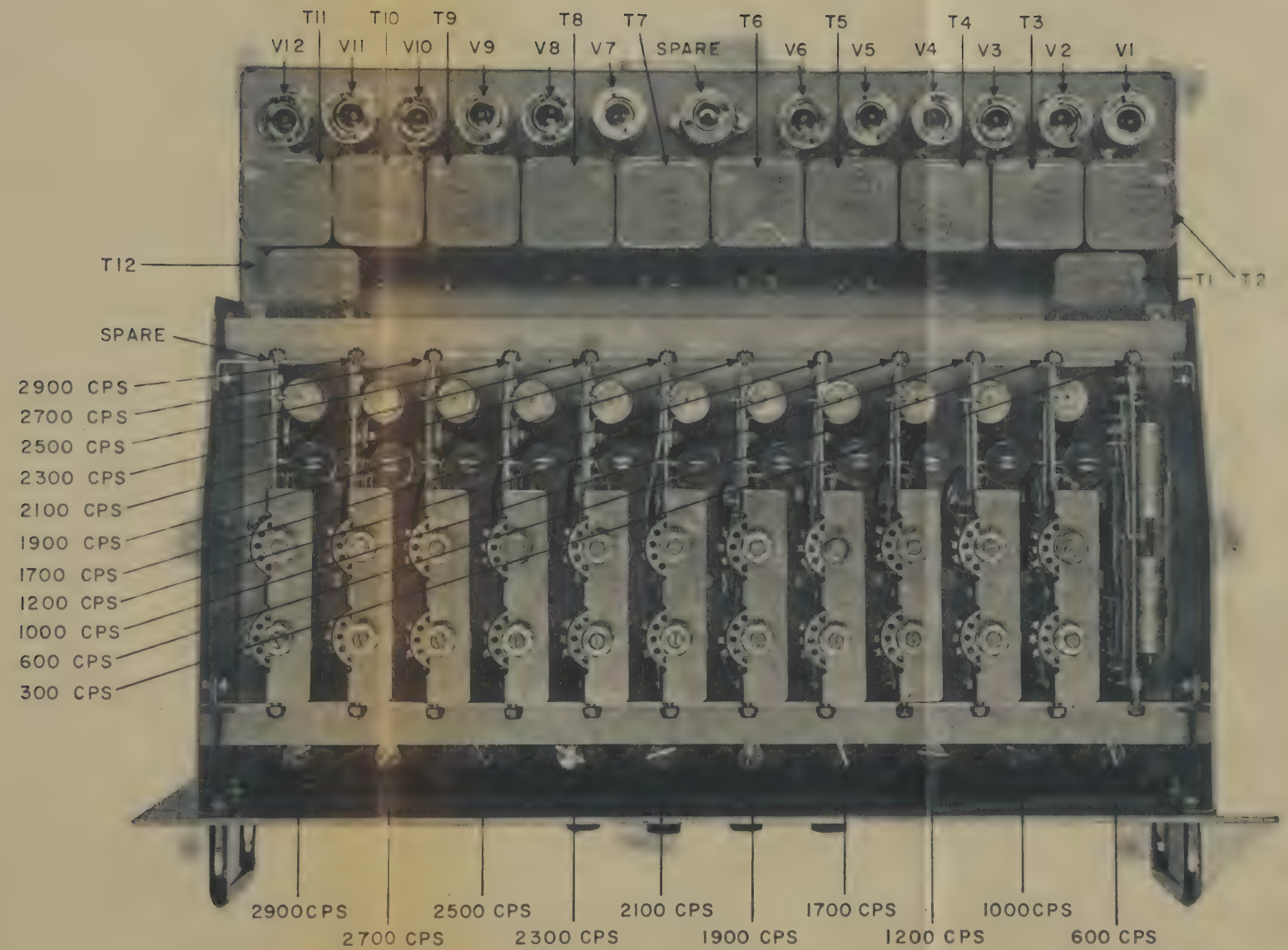
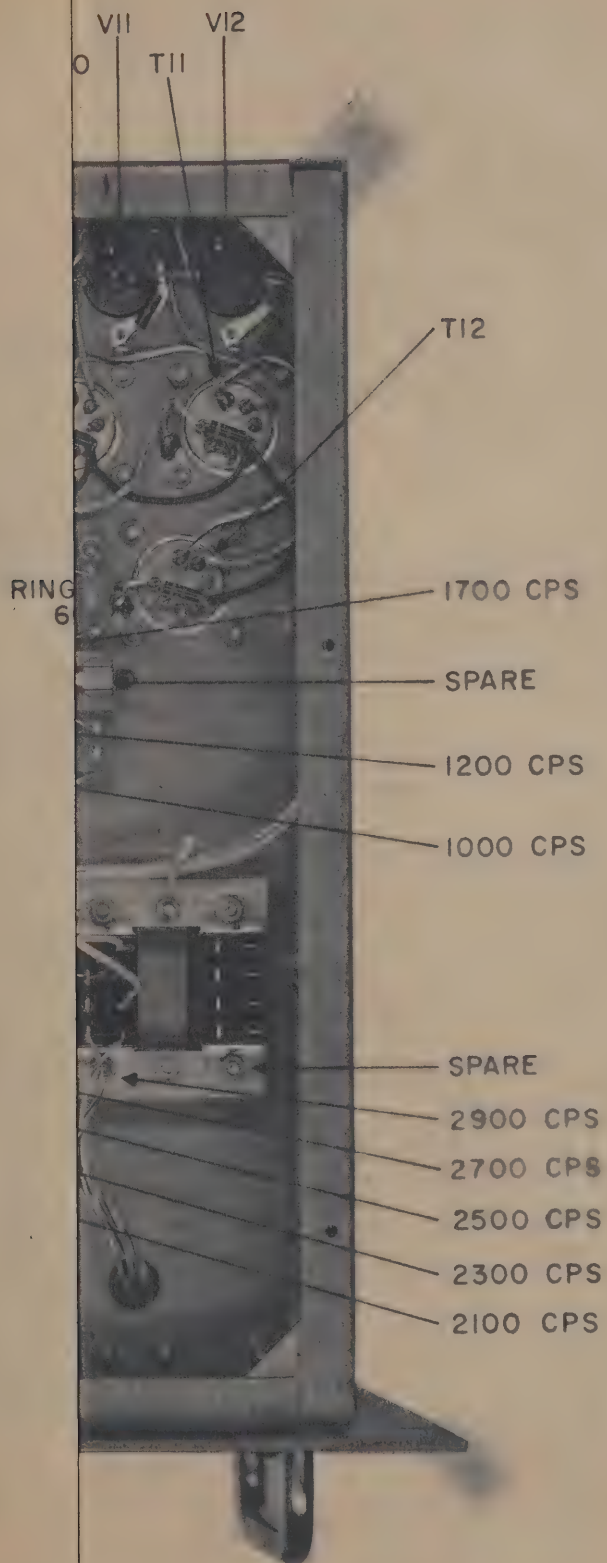


Figure 21. Tone Generator, Tap View



Generator, Bottom View

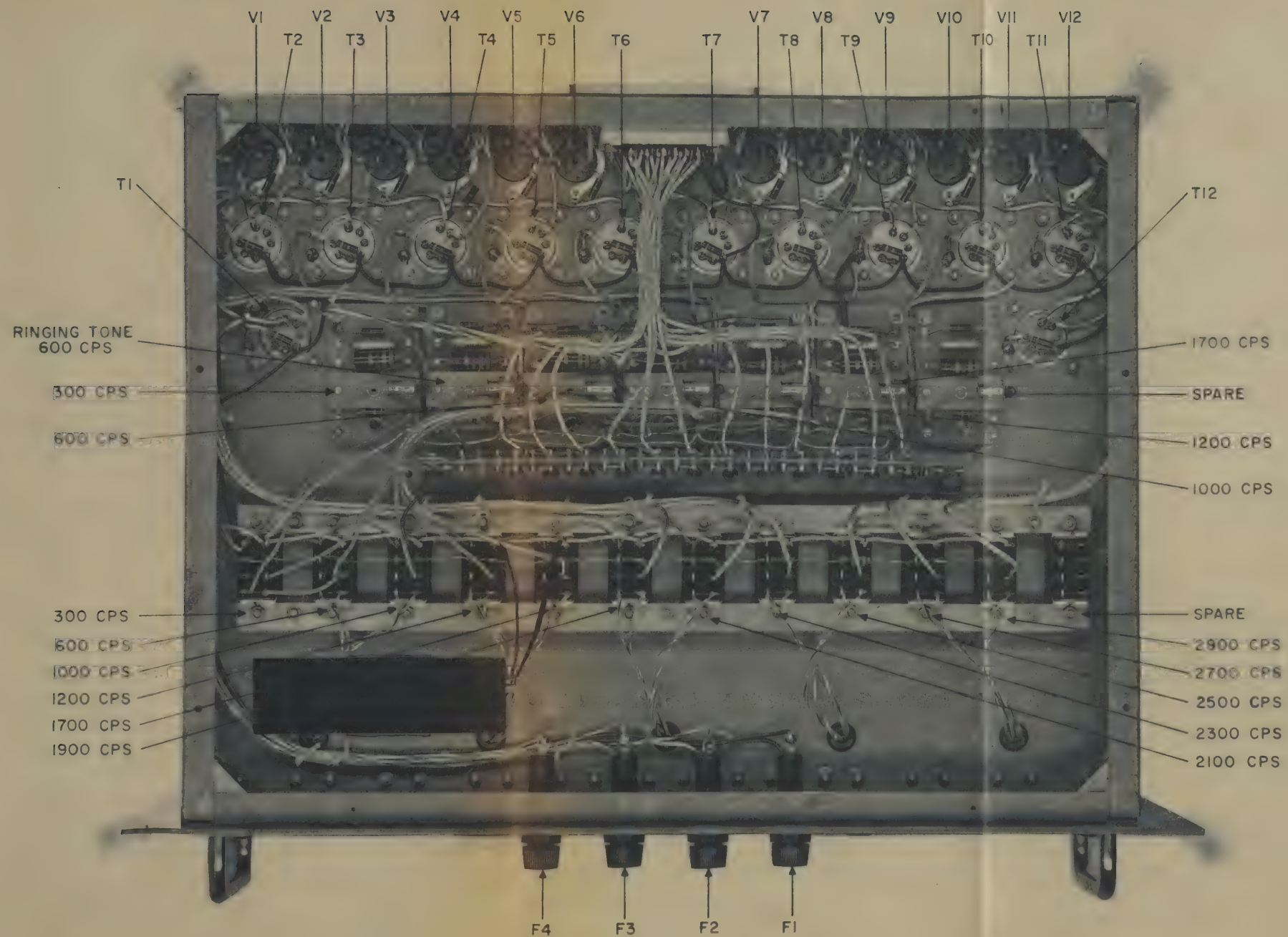


Figure 22. Tone Generator, Bottom View



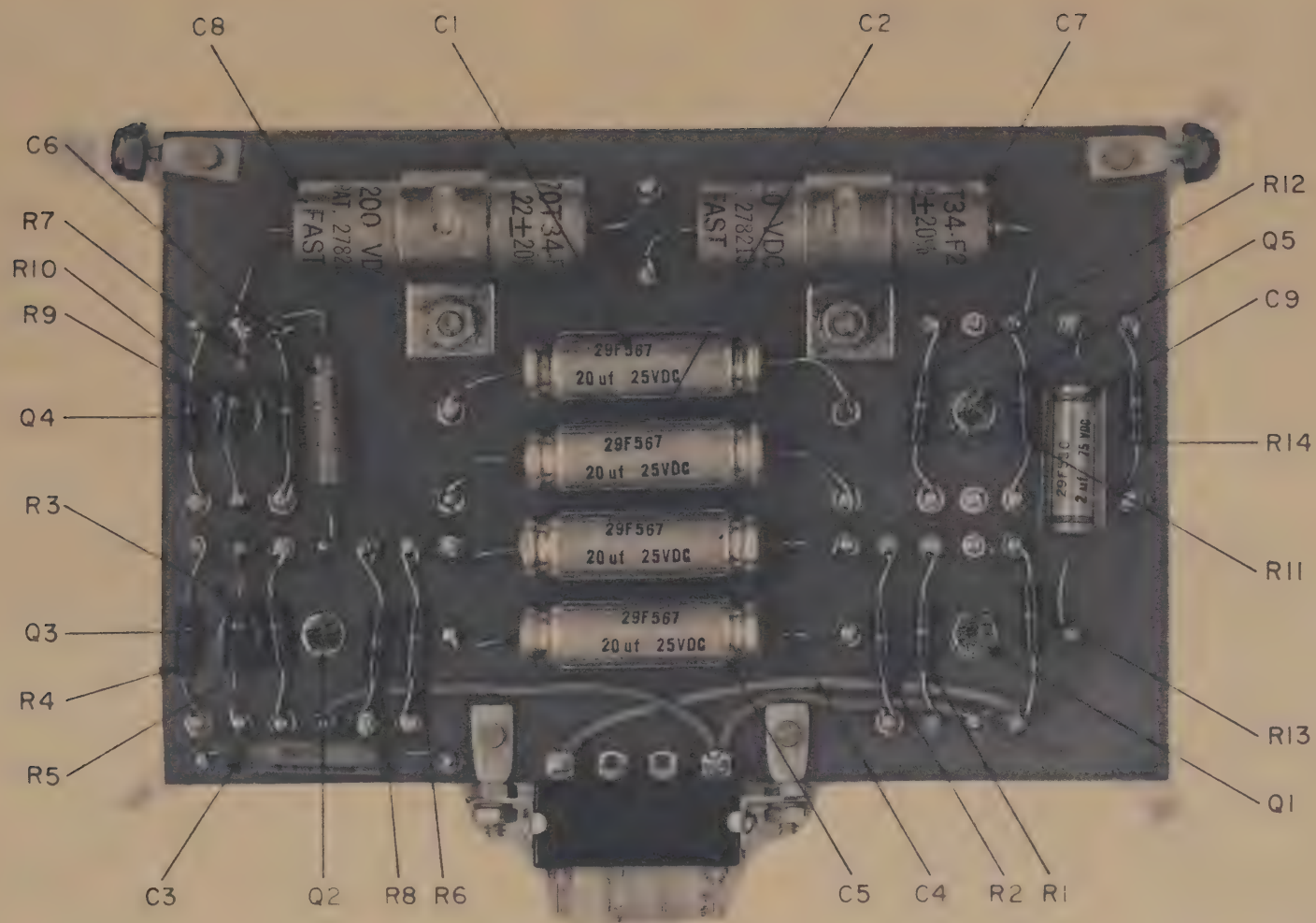


Figure 24. Tone Generator, 300 Cycle Oscillator And Multivibrator

and filament voltages required by the vacuum tube circuits are supplied by two 200-volt power supplies with their associated filament voltage supplies. A 300-milliampere 200-volt supply with a 12.6-volt filament supply provides the power requirements for the Decoder chassis and the tone generator chassis. A 85-milliampere 200-volt supply with a 12.6-volt filament supply provides the power requirements for the one-line manual switchboard. Figures 25 and 26 show the 200-volt supplies that are contained in one drawer of the Translation Equipment rack. The schematic diagram of the 200-volt supply is shown in figure 48.

b. Low-Voltage Transistor Supply. The -11-volt, +4-volt, and -4-volt sources required by the transistor circuitry is supplied by two transistorized high-current regulated power supplies. Rectified dc is obtained by means of full-wave rectification utilizing semi-conductor rectifiers. The rectified dc is passed through an LC filter combination before application to the transistor regulator. The regulator circuit consists of a high-current transistor-emitter-follower which is in series with the negative output buss of the rectifier-filter combination. A circuit diagram of each supply is shown in figure 49. These two supplies were manufactured by Electronic Research Associates, Inc.

30. ONE-LINE MANUAL SWITCHBOARD

The Translation Equipment for the Central station and the Subscriber station equipment was developed and fabricated without having access to the automatic switchboard. In order to test the above equipment, a one-line manual switchboard was fabricated.

a. This switchboard provides channel lights to inform the operator that a Subscriber has transmitted a seize tone and desired to talk with another Subscriber through the Central station. Provisions are provided so that the operator may connect the calling Subscriber to the called Subscriber by means of a patch cord. This is done after the Central operator calls the called Subscriber by pushing the ring button which sends out either 1200 or 1000 cycles depending on the Subscriber station called. When the called Subscriber answers, the channel indicator light is activated indicating the second Subscriber has seized the channel at the switchboard.

b. Digit indicator lights 1 through 0 and a recall light are also provided at the switchboard. These indicator lights are connected to detector circuits which are tuned to the frequencies of the compound tones required by the automatic switchboard. The inputs to these circuits are connected to the Line Translator chassis. A Subscriber may check the accuracy of his push button dialing on the Control Head of the Subscriber and the Translation Equipment in the Central station simply by dialing any given number. This provides a complete system check without the use of the automatic switchboard. Figures 27 and 28 show the one-line

manual switchboard that is contained in one drawer of the Translation Equipment rack.

31. CENTRAL STATION NOISE BLANKER

The Central station noise blanker (figures 29 and 30) uses a similar scheme to the Subscriber noise blanker, but due to the multi-channel feature, it is necessary to use a blanking pulse of as narrow duration as is practicable. A modified bistable multivibrator is used to produce a blanking pulse with a sharp trailing edge, since intermodulation between the blanking pulse and an adjacent-channel desired signal will reduce the blanker effectiveness. Up to 26 db of blanking has been obtained with the Central station noise blanker using an 8-microsecond blanking pulse.

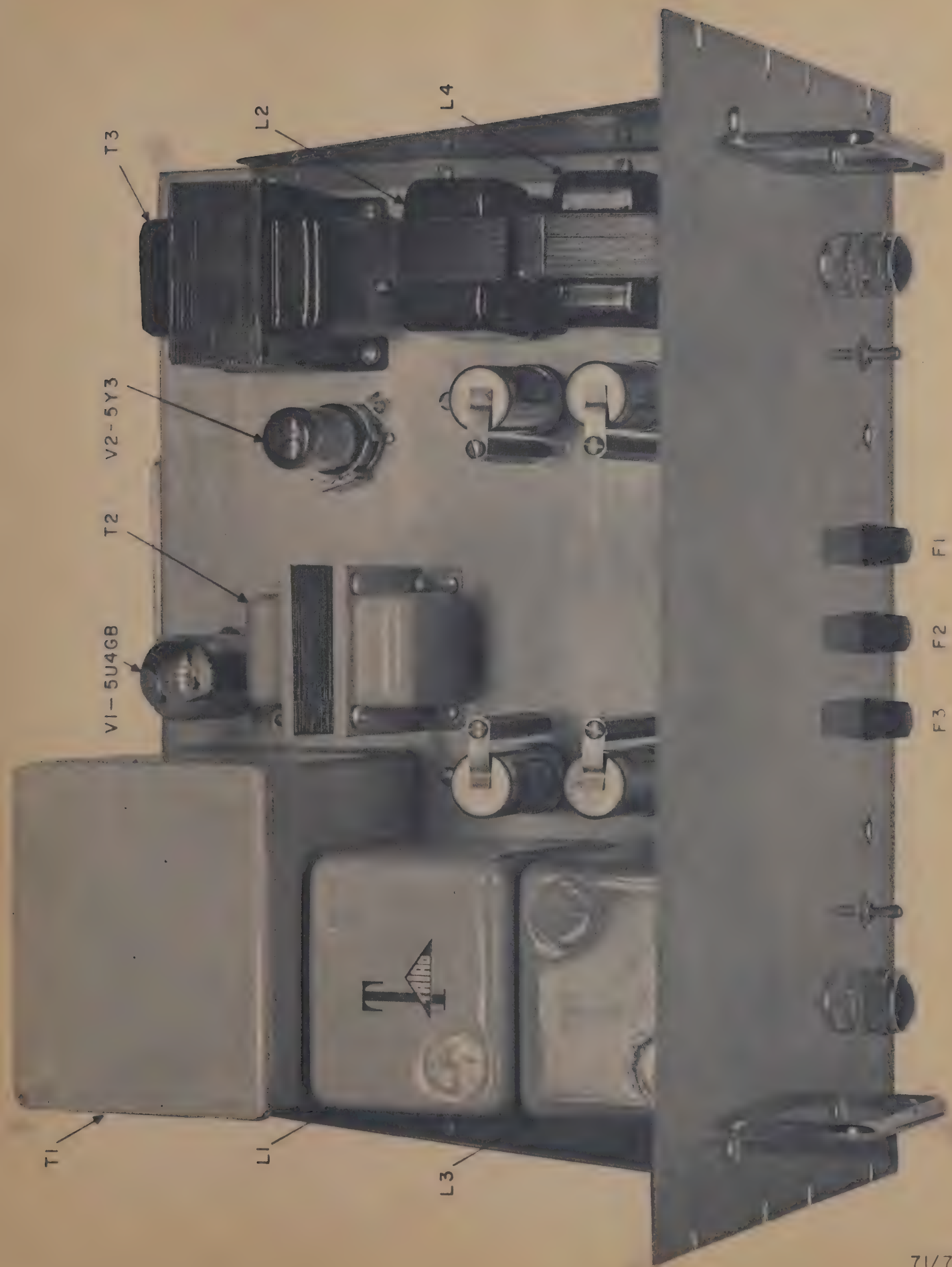
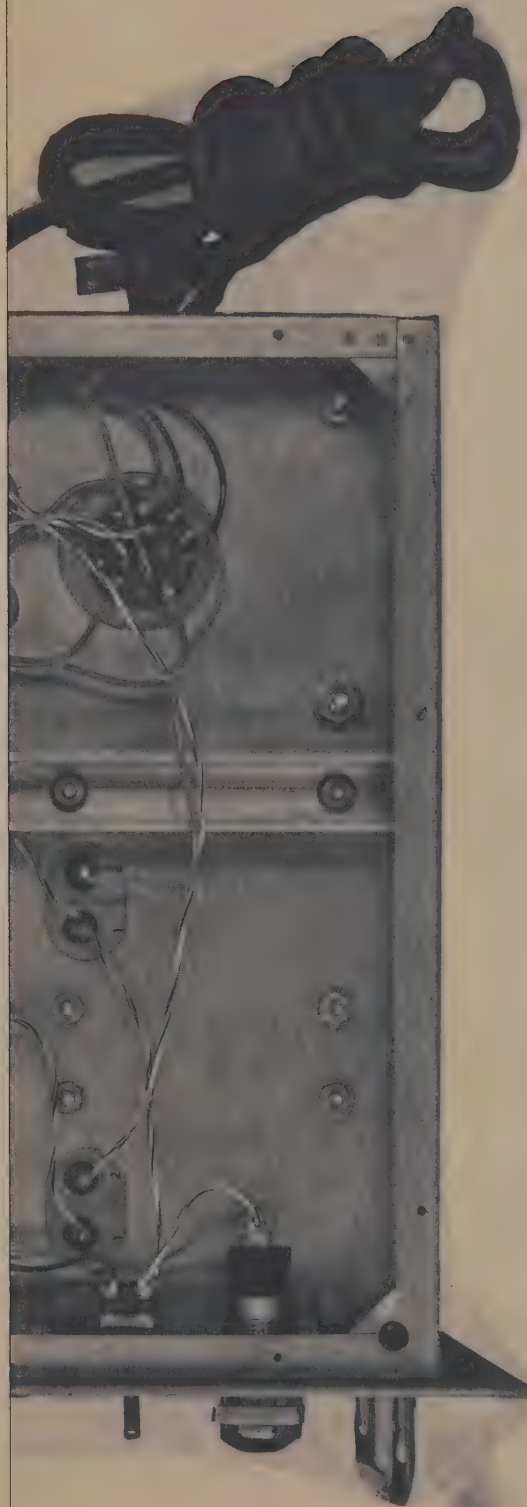


Figure 25. 200-Volt Power Supply, Top View



olt Power Supply,
View

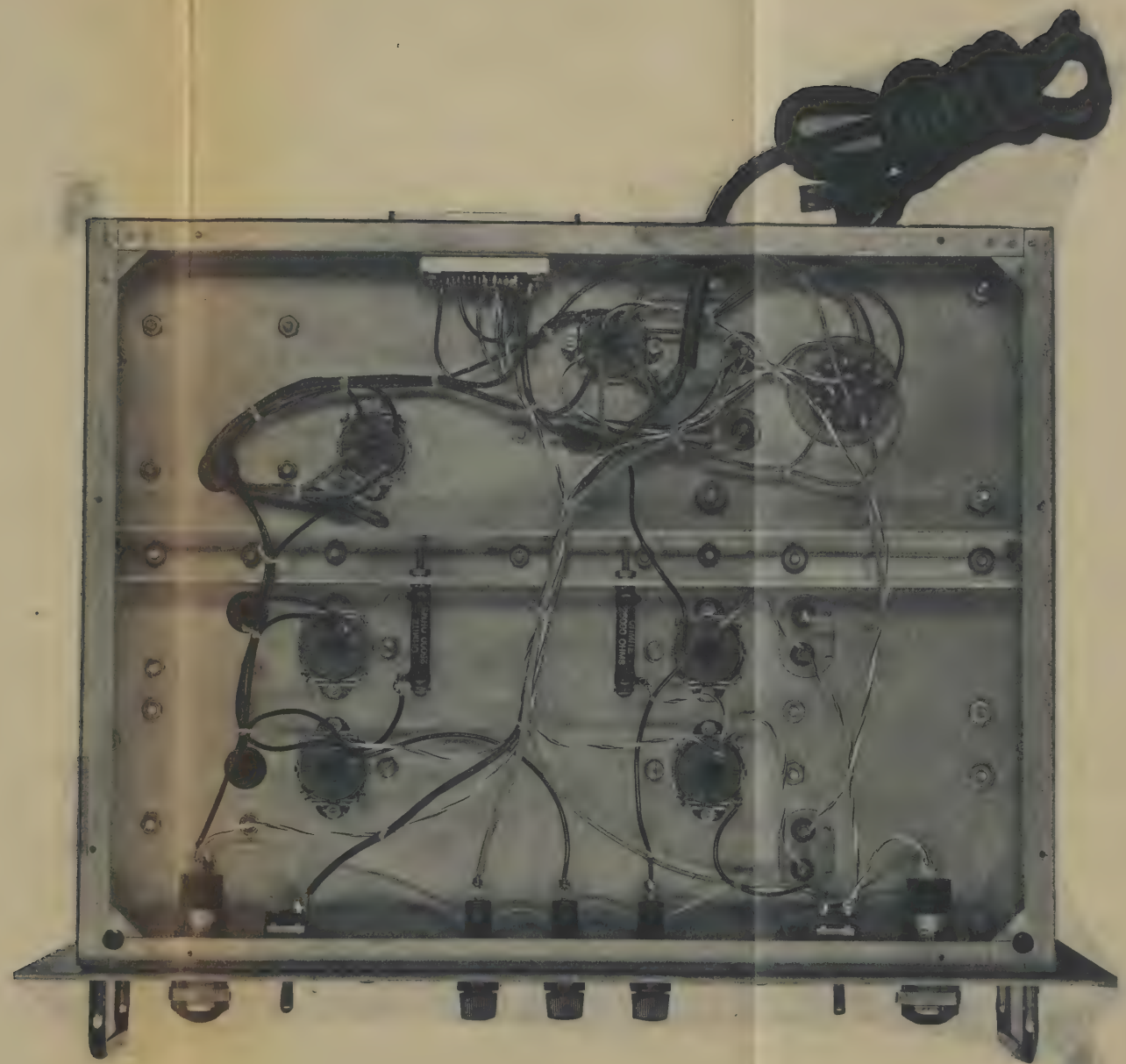
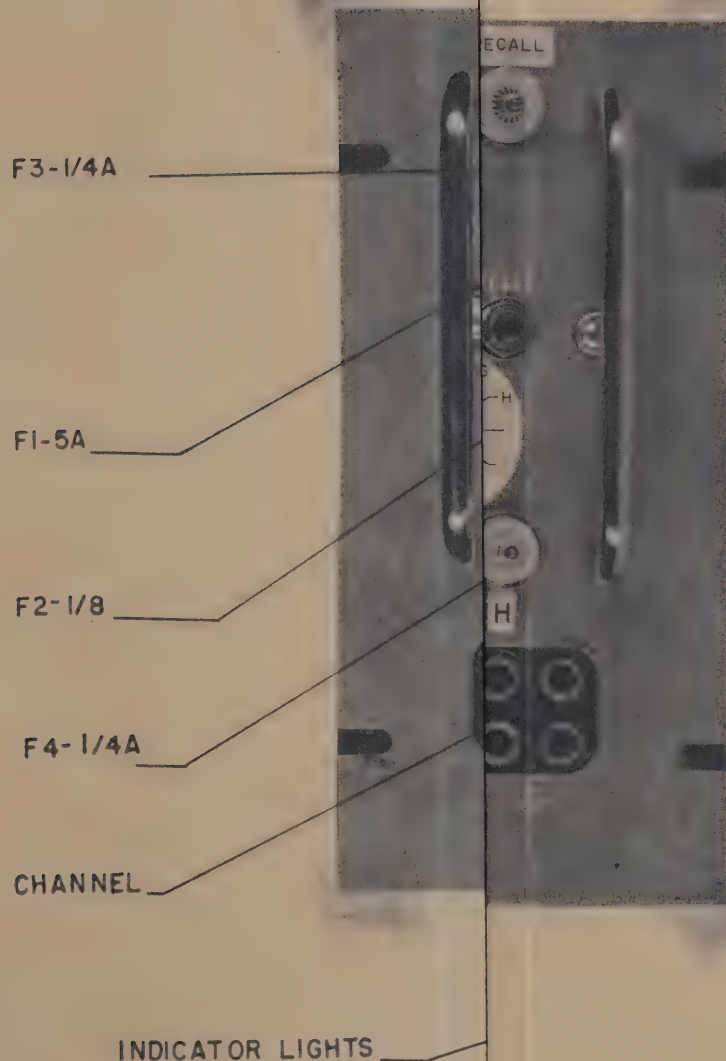


Figure 26. 200-Volt Power Supply,
Bottom View



e 27, One-Line Manual Switchboard

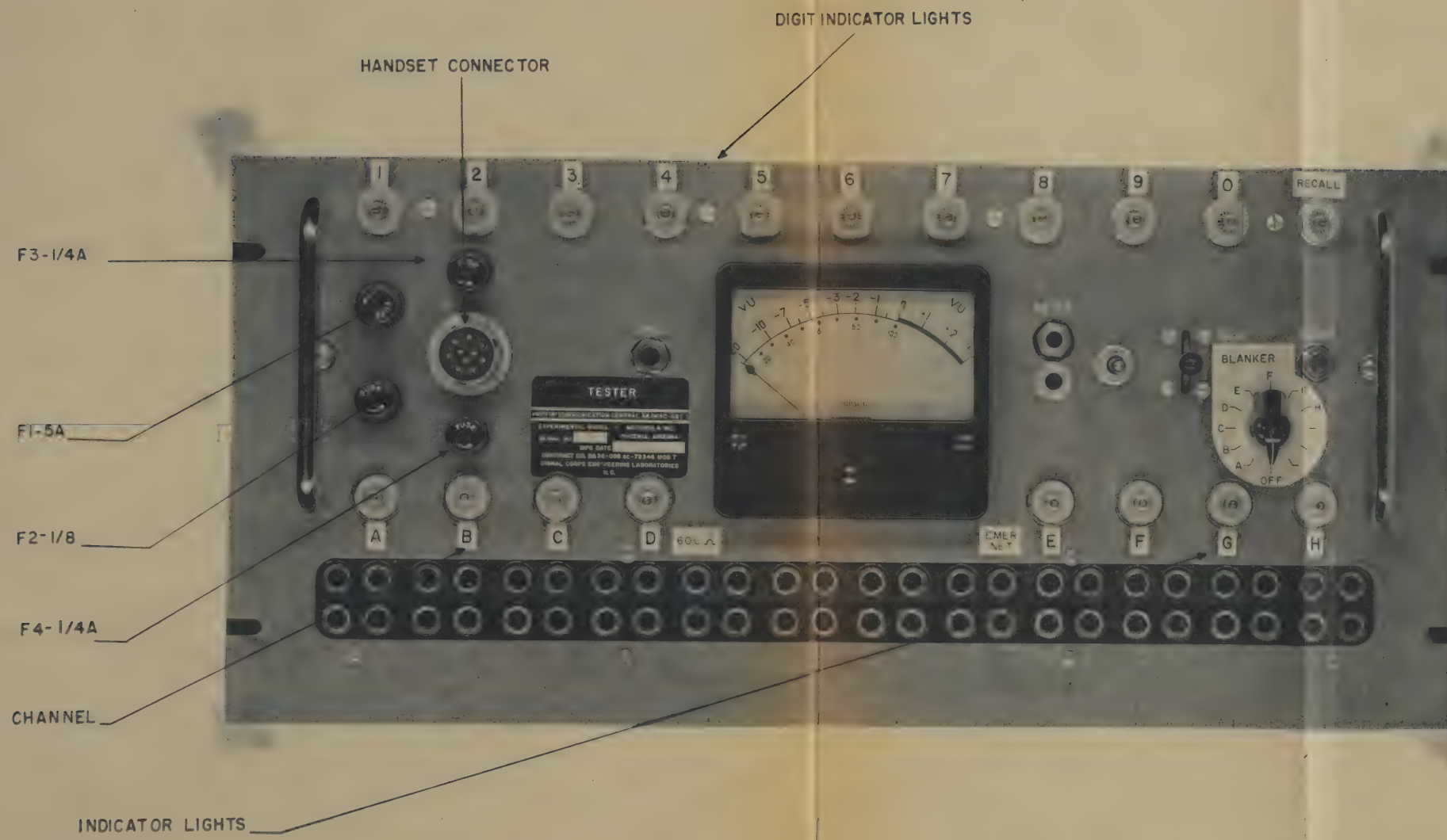
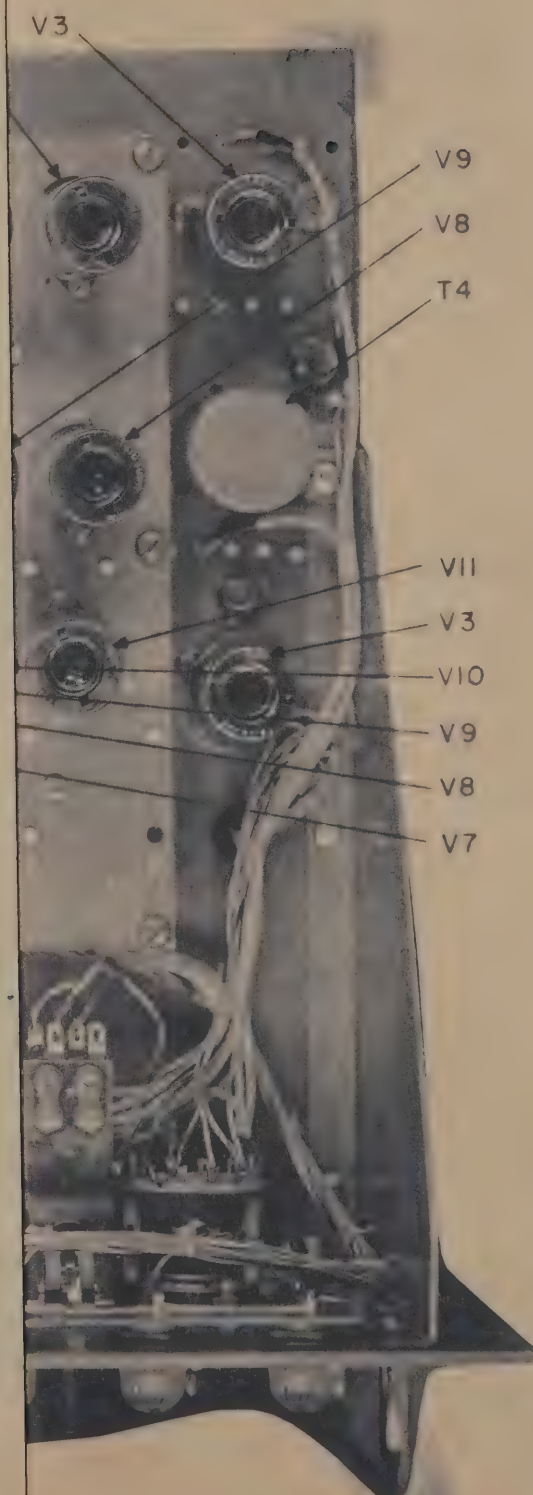


Figure 27. One-Line Manual Switchboard





e Manual Switchboard ,Top View



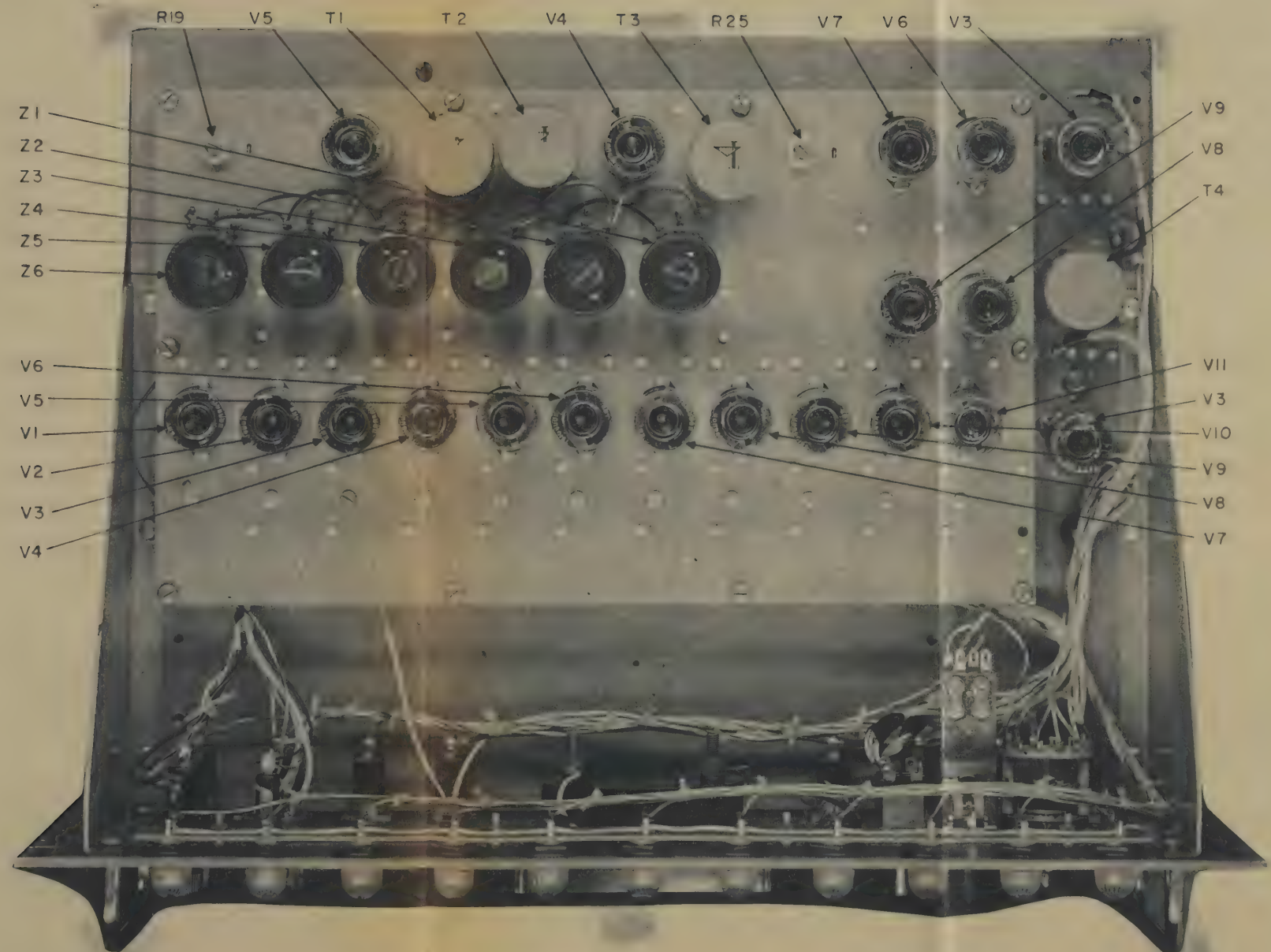


Figure 28. One-Line Manual Switchboard, Top View

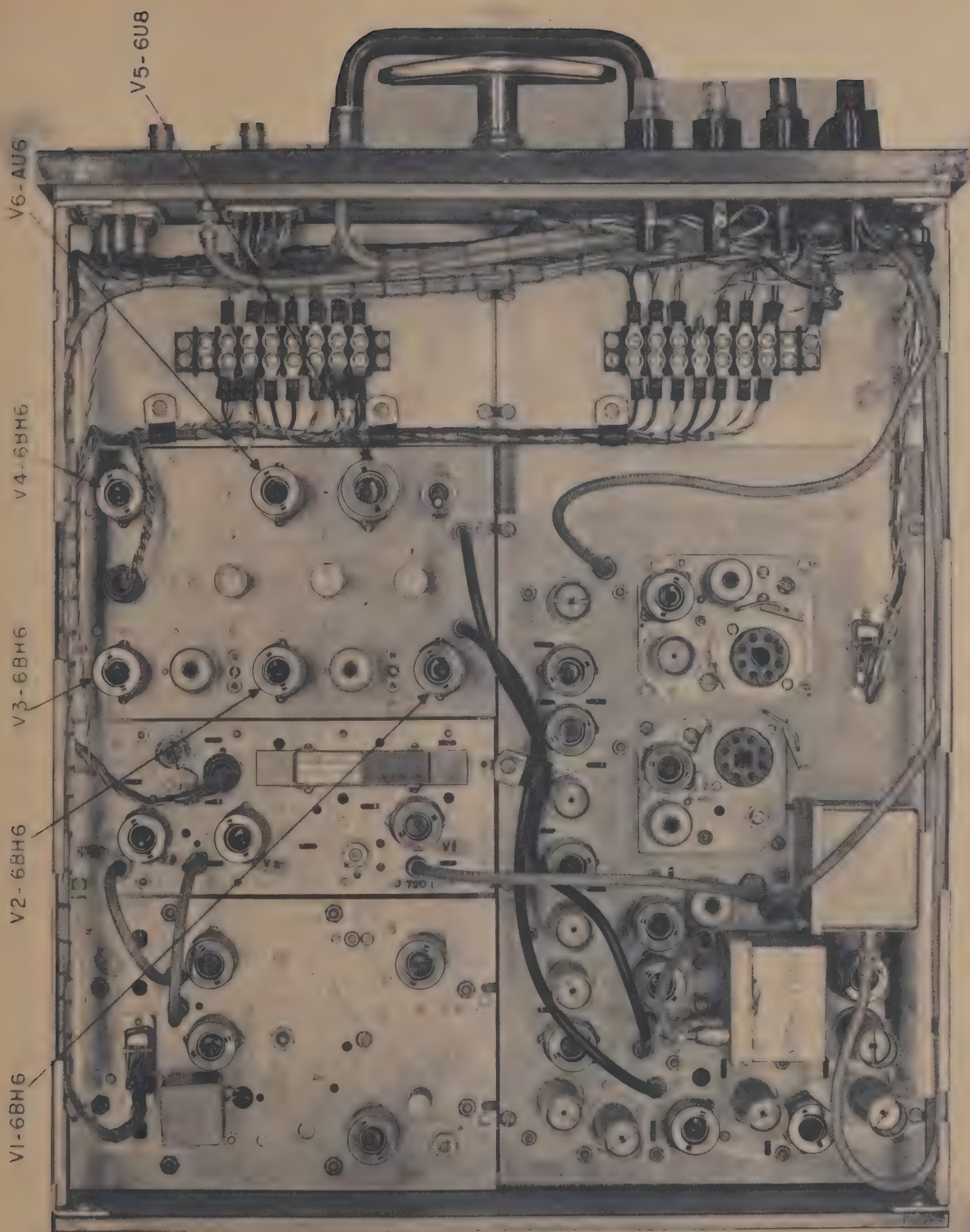
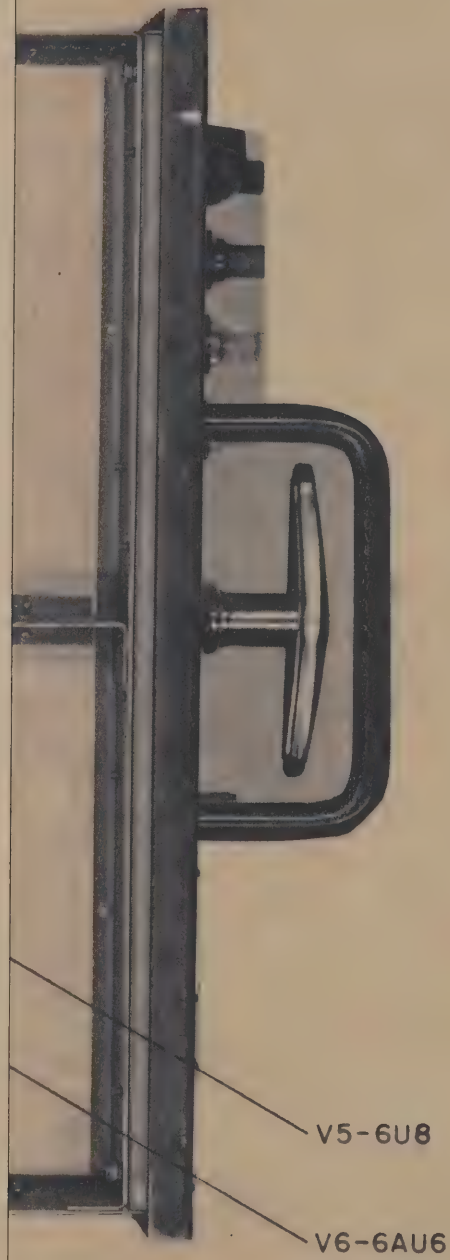


Figure 29. Central Station VHF Receiver And Noise Blunker, Top View



Station VHF Receiver and
Blanker, Bottom View

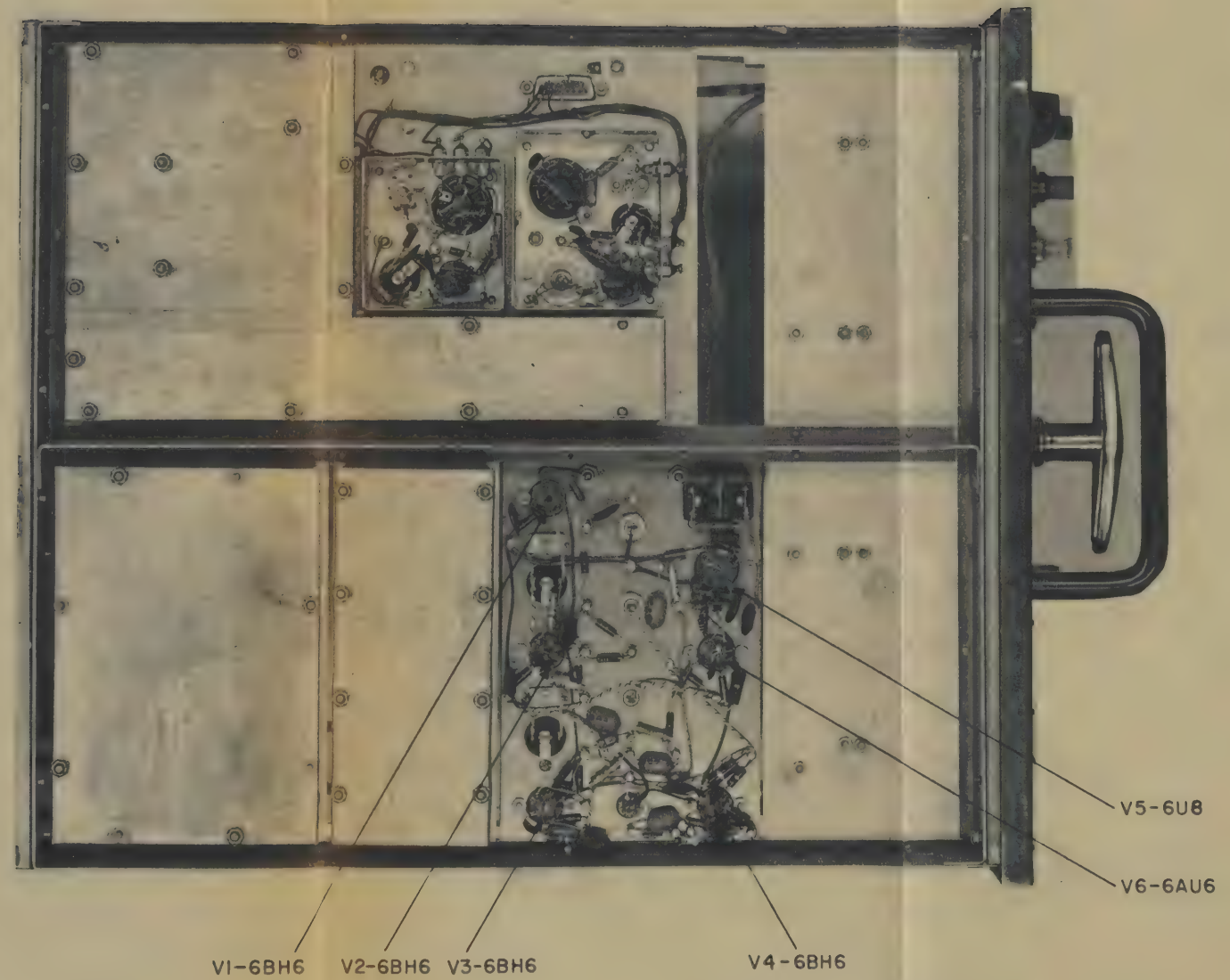


Figure 30. Central Station VHF Receiver and
Noise Blanker, Bottom View

CHAPTER 4
MAINTENANCE
SECTION I. TROUBLESHOOTING

32. GENERAL

It has been assumed that troubleshooting of this equipment is to be handled by engineers or highly-competent technicians. The equipment units are factory-adjusted with special laboratory equipment (see Section II). Readjustment in the field should not be attempted without this special equipment. Primary troubleshooting information is graphically displayed in photographs, charts, and schematic diagrams. See Chapter 3, Section I, paragraph 20 for listings.

SECTION II. ALIGNMENT PROCEDURES

33. GENERAL

The alignment and adjustment of the transmitting and receiving equipment for the Central base station and the Subscriber sets is described in books 1 and 2, the Communication Central AN/MRC-66() Subscriber equipment, and Communication Central AN/MRC-66() Central Equipment. This manual will deal only with the equipment used for automatic dialing.

34. SUBSCRIBER CONTROL HEAD, MAINTENANCE DATA

The data contained in Chapter 3, Section II, paragraph 20 should be reviewed prior to attempting troubleshooting of the Control Head. The theoretical discussion contains service data such as operating voltages, switching routines, and circuit description, the knowledge of which will increase troubleshooting efficiency. The following illustrations are referred to for maintenance supportive data.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
7	Subscriber Control Head, Front View	25/26
32	Subscriber Control Head, Schematic Diagram	95/96
33	Subscriber Control Head, Component Board Schematic	97/98
8	Subscriber Control Head, Internal View	29/30
31	Subscriber Control Head, Relay Connection Diagram	85/86

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
9	Subscriber Control Head, Component Board	31/32
Table III.	Subscriber Control Head, Voltage Monitoring Points	87

35. RECEIVER AND SSB GENERATOR AUDIO AMPLIFIER CABINET

In order to obtain a sufficient audio level and the proper impedance value for the SSB generators, and for the sequential tone decoders in the Central station, each receiver and transmitter channel has been provided with an audio amplifier. A circuit diagram of these amplifiers is shown in figure 40. The following adjustments are required for proper operation of the audio amplifier circuits and radio Central equipment:

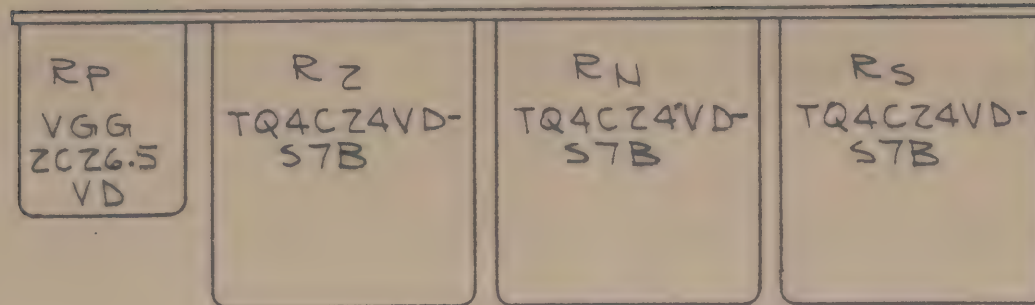
a. Receiver AGC Adjust.

- (1) Connect the Motorola SSB Signal Generator to the VHF receiver antenna input.
- (2) Calibrate the signal generator on each channel with the same carrier-to-sideband ratio as is used in the Subscriber stations.
- (3) Set the signal Generator output to .25 microvolts with the attenuator dial.
- (4) Adjust the AGC voltage to 1-volt by means of the AGC adjust pot on each channel of the LF receiver i-f amplifier R2.

b. Audio Level Adjustment.

- (1) Connect the Motorola SSB Signal Generator to the VHF receiver antenna input.
- (2) Set the signal Generator as in the receiver AGC adjustments of subparagraph a(2).and (3).
- (3) Adjust R22 of the LF receiver exalted carrier detector so the output of the receiver channel audio output that is connected to the Decoder chassis in the Translation Equipment rack is 0.3 vrms on a VTVM. This adjustment is repeated for each channel.
- (4) Patch a receive channel to a send channel at the one-line manual switchboard, and adjust R7 of the SSB amplifier (figure 14) so the output voltage is 0.1 vrms. This is done with 0.3 vrms appearing at the Decoder chassis.for each channel.

SUBSCRIBER CONTROL UNIT RELAYS



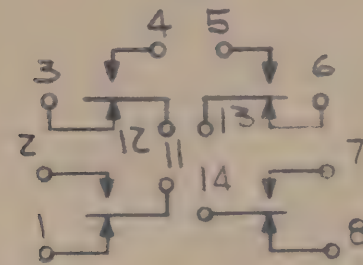
MTG STD



MTG STD S

VGG ZCZ6.5 VD

MTG STD



MTG STD

TQ4CZ4VD-S7B

MTG STD

Figure 31. Subscriber Control Head, Relay Connection

TABLE III
SUBSCRIBER CONTROL HEAD, VOLTAGE MONITORING POINTS

TEST POINT	VOLTAGE
A2	11 (6)
A3	15
A5	15 (11)
A9	15
A10	15 (10.5)
A13	15 (10)
A15	15
A16	4 (4.9)
A18	15 (5)
A20	15
A21	2 (11)
A23	15 (10)
A25	15 (10)
A27	15
A29	2 (3.3)
A30	0 (11)
A31	0 (11)

TEST POINT	VOLTAGE
A33	.05 $\frac{11}{(.05)}$
A35	15
A40	.9 (11)
A41	15
A42	15 (11)
A44	15
A45	.15 (3.5)
A47	0
A48	0
B2	11
B4	11 (13)
B5	0
B6	11
B9	15 (11)
B16	11
B17	0
B19	2 (5.1)
B20	15 (10.5)

TEST POINT	VOLTAGE
B21	0
B22	11
B28	11
B29	0
B30	0
B33	0
B34	11 (11)
B35	6.7 (12.8)
B37	11
B40	0
B41	15 (11)
B44	15 (3.3)
B47	2 (3.3)
B48	11 (11)
C1	11
C2	11 9 (11)
C3	13.8 4.2 (13.8)

TABLE III (cont)

TEST POINT	VOLTAGE
C5	11
C6	0
C7	0
C8	.14 $\frac{5}{(7.14)}$
C14	13 (6.7)
C15	0
C18	11 (13)
C20	11 $\frac{9.5}{(11)}$
C21	11
C22	2 (3.3)
C25	15 (3.4)
C27	15 $\frac{5}{-}$
C28	.1 $\frac{5}{(.1)}$
C29	11
C30	0
C35	15 * 0
C37	13.8 $\frac{4.2}{(13.8)}$

TEST POINT	VOLTAGE
C40	15 (11)
C41	15 $\frac{5}{(15)}$
C43	15 $\frac{5}{(15)}$
C47	2 (3.3)
D1	11 $\frac{9}{(11)}$
D3	13.7 $\frac{8.7}{(13.7)}$
D4	15
D5	2 $\frac{4.8}{(2)}$
D6	2
D9	15
D10	13.8 $\frac{4.2}{-}$
D11	.07 $\frac{11}{(.07)}$
D13	11 (6)
D15	15 (1)

TEST POINT	VOLTAGE
D17	15
D18	2 (11)
D20	15 $\frac{9.3}{(15)}$
D21	11 $\frac{9.5}{(11)}$
D22	11 (3.6)
D27	15
D29	2 $\frac{4.9}{(2)}$
D32	10.6
D35	15
D47	11
E1	11 $\frac{9}{(11)}$
E2	11 $\frac{9}{(11)}$
E4	13.8 $\frac{8.5}{(13.8)}$
E6	2 $\frac{4.8}{(2)}$

TABLE III (cont)

TEST POINT	VOLTAGE
E7	2 <u>4.8</u> (2)
E10	11 11 (11)
E12	15
E13	2 (11)
E14	11 8 *27
E16	15 * 0
E30	11.7
F36	15 <u>5.5</u> (15)
F37	15 <u>5.5</u>
F39	15
F40	15 (11)
F41	15 <u>5.5</u> (15)
F43	15 <u>5.5</u> (15)
G1	11

TEST POINT	VOLTAGE
G2	11
G4	11
G5	15 5 (15)
G6	11
G7	0
G9	0
G10	11 5 (11)
G11	0 (11)
G13	6.3 (12)
G15	11 9 (11) *27)
H7	10.6
H12	10.6
H17	10.6
J25	8.6
K34	8.6
K40	11 9 (11)

TEST POINT	VOLTAGE
L22	8.5
L23	15
L24	0
L29	0
L30	8.6
L31	0
L32	0
L33	11.7
L34	11.9
L36	15 <u>5.5</u> (15)
L44	11
L46	11 9 (11)
L47	0
N12	11 9 (11)
N13	11 9 (11)
N14	0 (11)
N15	15 0 —

TABLE III (cont)

TEST POINT	VOLTAGE	TEST POINT	VOLTAGE	TEST POINT	VOLTAGE
N16	.1 (11)				
N19	10.8				
N24	10.6				
N25	10.6				
N29	8.5				
N31	1.7				
N33	11				
N34	15				
N35	8.6				
N36	15				
N37	15 5.5 (15)				
N38	11 9 (11)				
N48	8				

Notes:

All voltages measured with hook switch "off" hook.

Underlined numerals indicate voltage measured during timing interval.

() Numerals within parenthesis indicate voltage measured after timing interval.

* Numerals preceded by asterisk indicate voltage measured with hook switch "on" hook.

All 15V, 11V and 0V supply voltages are 27V when hook-switch is on hook.

- (5) Clipping level at the SSB generator is checked by disconnecting the send line from the receive line, connecting an audio oscillator to the send line, and setting the level until the input to the SSB generator is 0.3 vrms. Clipping should start to appear at the grid of V4 of the SSB generator with this level of signal.

CHAPTER 5
DRAWINGS

36. GENERAL

The following is the list of drawings in order of appearance in this chapter.

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
32	Control Head, Schematic Diagram	95/96
33	Control Head, Component Board Schematic Diagram	97/98
34	Subscriber Decoder And Audio Amplifier, Schematic Diagram	99/100
35	Subscriber Noise Blanker And Receiver Modification	101/102
36	Radio Central Automatic Dialing Translation Equipment, Operational Block Diagram (Single Channel)	103/104
37	Interconnecting Diagram, Intracabinet Signal Radio Central Equipment	105/106
38	Translation Equipment Intracabinet Cabling Diagram (Power)	107/108
39	Translation Equipment Intracabinet Cabling Diagram (Signaling)	109/110
40	Receiver And SSB Audio Amplifier Schematic Diagram	111/112
41	Receiver And SSB Generator Audio Amplifier Cabinet, Cabling Diagram	113/114
42	Central Station Decoder Chassis, Schematic Diagram	115/116
43	Dial Translator (Single Channel), Schematic Diagram	117/118
44	Dial Translator Intrachassis Cabling Diagram	119/120
45	Line Translator (Single Channel), Schematic Diagram	121/122
46	Line Translator Intrachassis Cabling Diagram	123/124
47	Tone Generator Schematic Diagram	125/126
48	200-Volt Power Supply Schematic Diagram	127/128
49	Transistorized High-Current Regulated Power Supply	129/130
50	One-Line Manual Switchboard Block-Diagram	131/132
51	One-Line Manual Switchboard Schematic Diagram	133/134
52	Central Station Noise Blanker Schematic Diagram	135/136

1. UNLESS OTHERWISE INDICATE
ALL RESISTORS ARE IN OHMS
ALL CAPACITORS ARE .25 UF
2. WITH EXCEPTION OF JACK
& PLUGS, REFERENCE DESIGNATIONS ARE ABBREVIATE
ADD 200 TO REFERENCE
NUMBERS, THAT IS; READ F
AS REQ1.
3. DASHED CIRCUIT SHOWN
FOR REFERENCE ONLY.

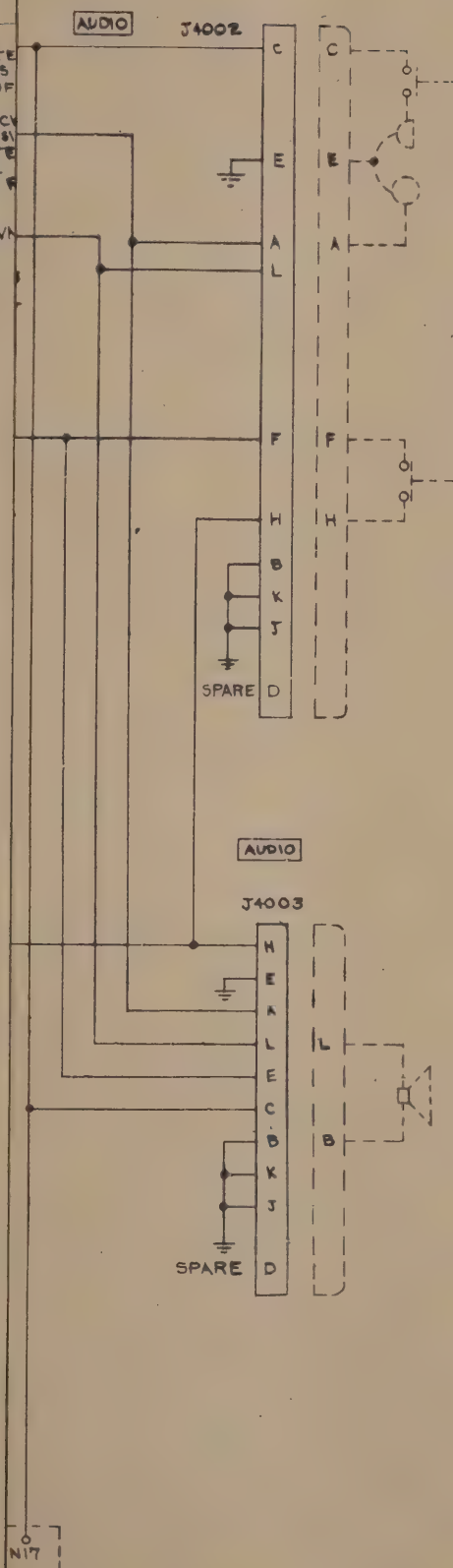


Figure 32. Control Head, Schematic Diagram

1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS ARE IN OHMS
ALL CAPACITORS ARE .25 UF.

2. WITH EXCEPTION OF JACKS
& PLUGS, REFERENCE DESIGN-
ATIONS ARE ABBREVIATED.
ADD 200 TO REFERENCE
NUMBERS, THAT IS; READ R1
AS R201.

3. DASHED CIRCUIT SHOWN
FOR REFERENCE ONLY.

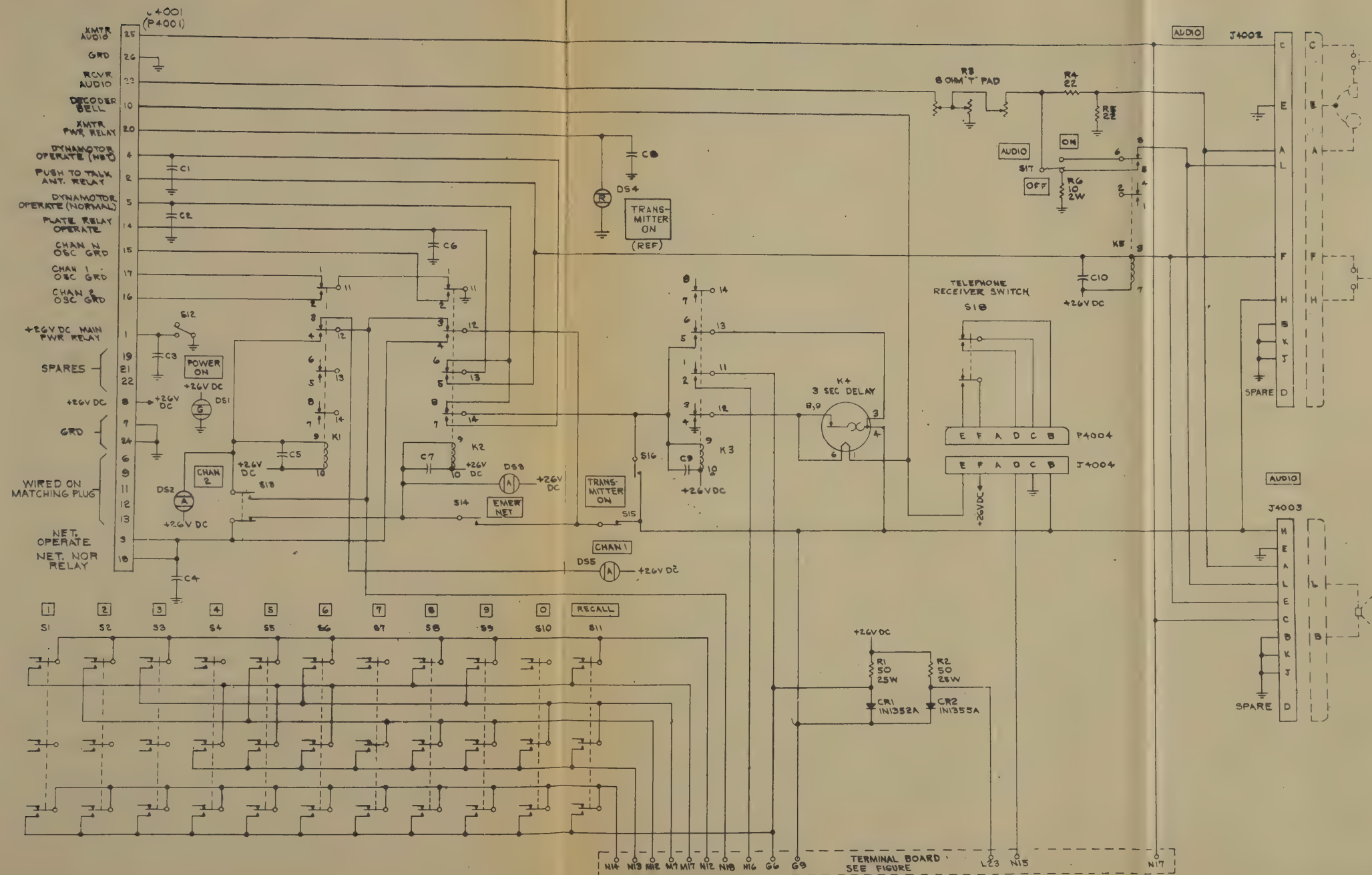


Figure 32. Control Head, Schematic Diagram

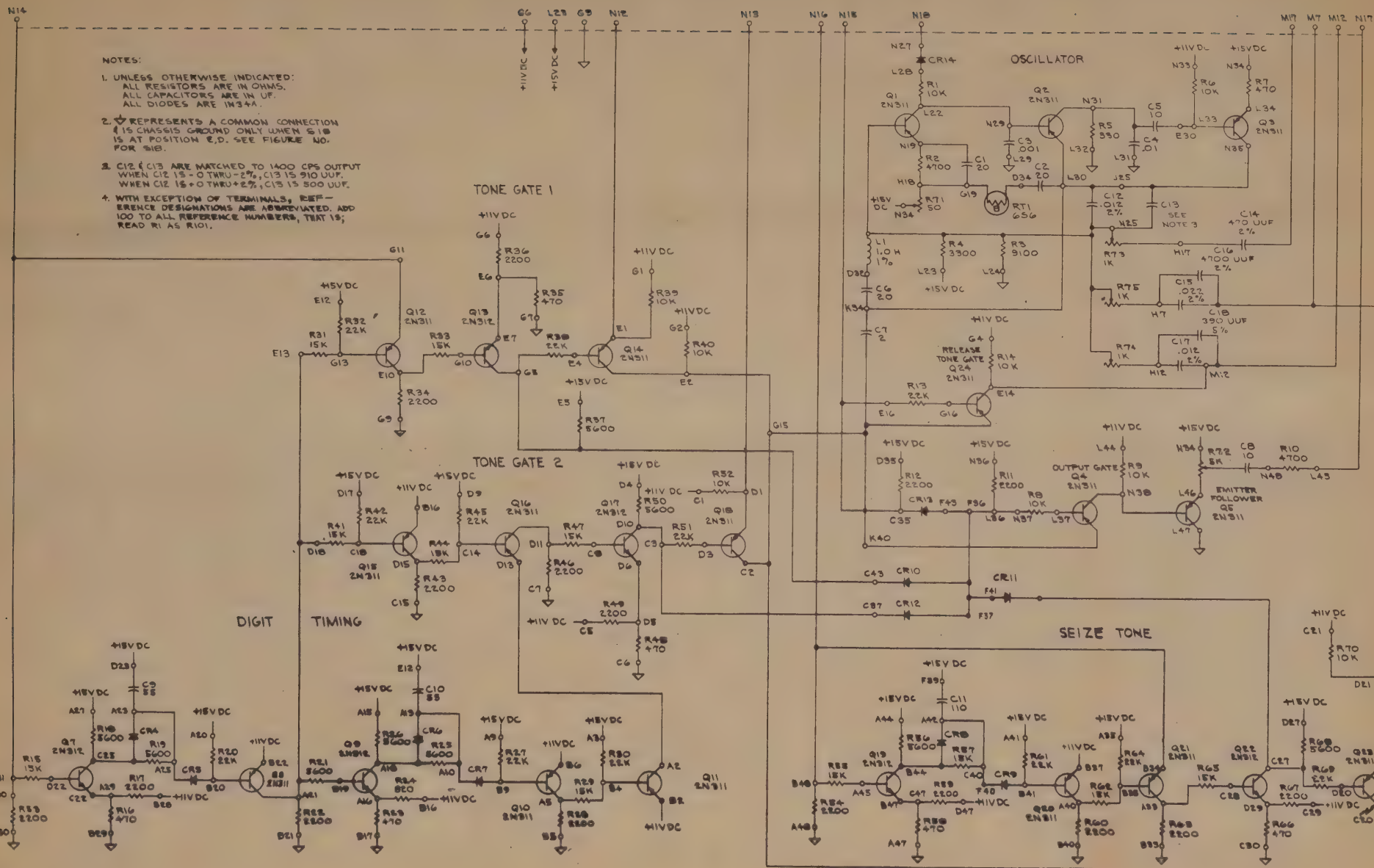
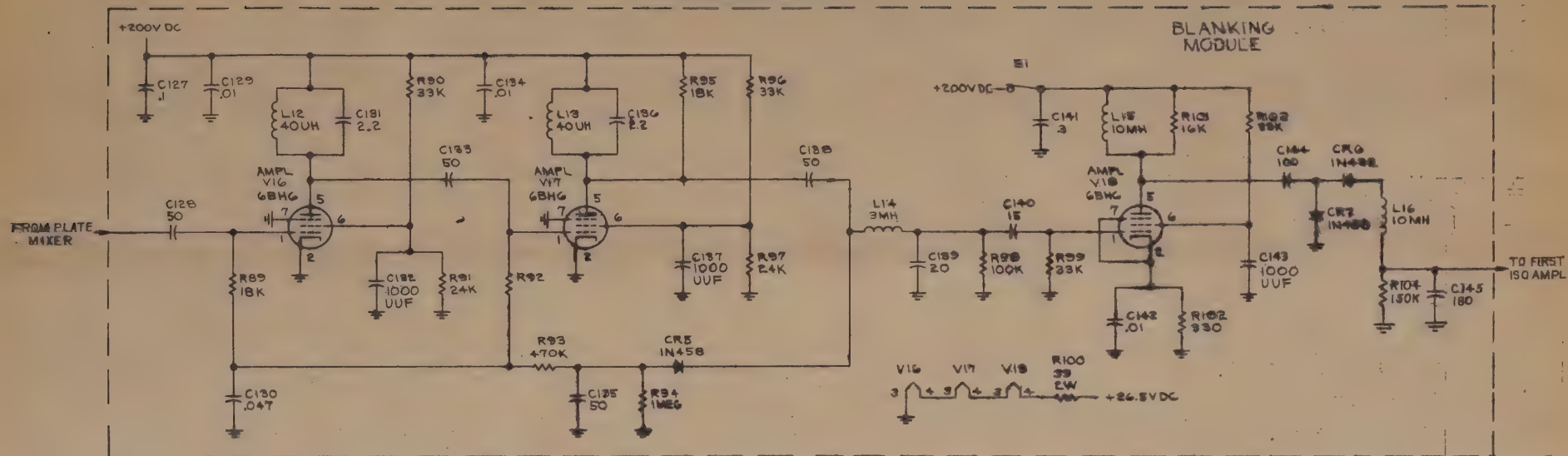


Figure 33. Control Head, Component Board Schematic Diagram

- 99/100



MODIFICATION TO FIG. 4.3D
(SUBSCRIBER EQUIPMENT)



MODIFICATION TO FIG. 4.4P
(SUBSCRIBER EQUIPMENT)

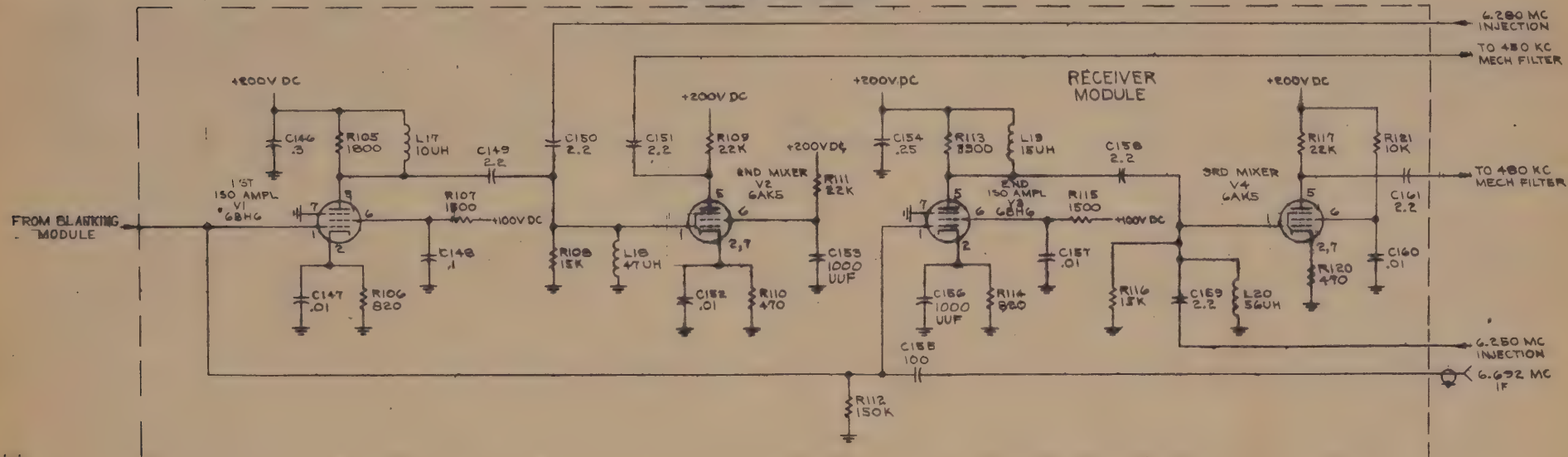
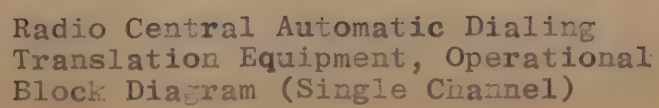


Figure 35. Subscriber Noise Blanker And Receiver
Modification



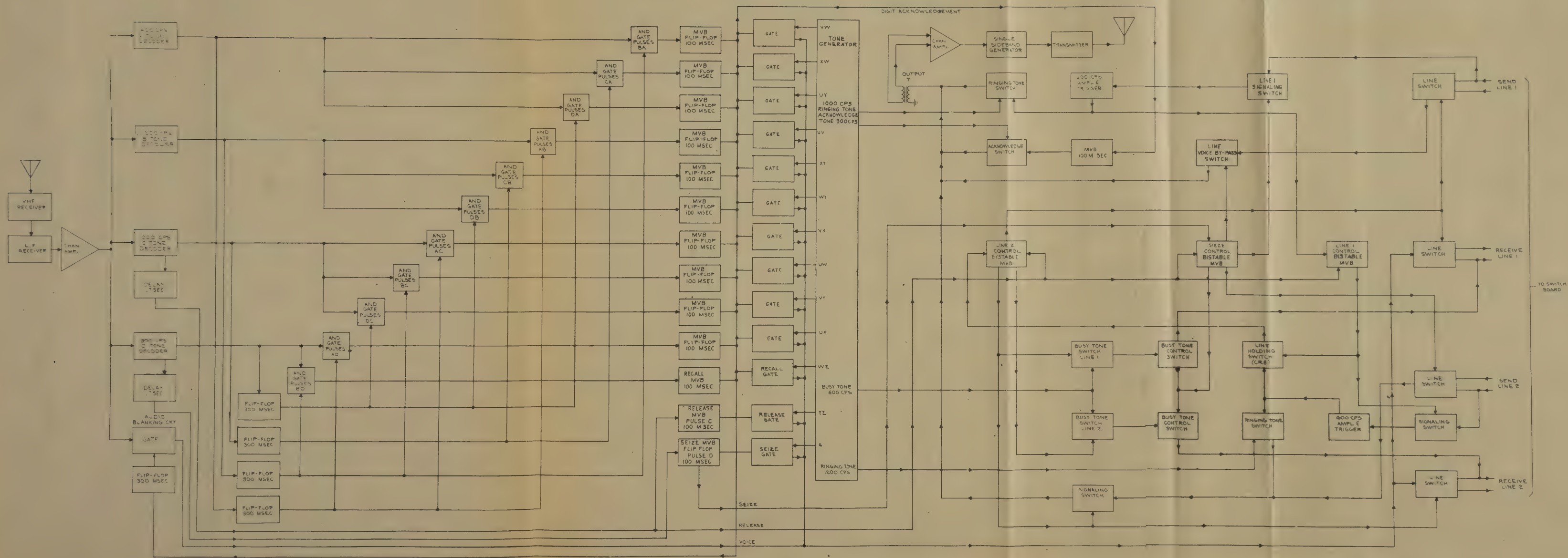
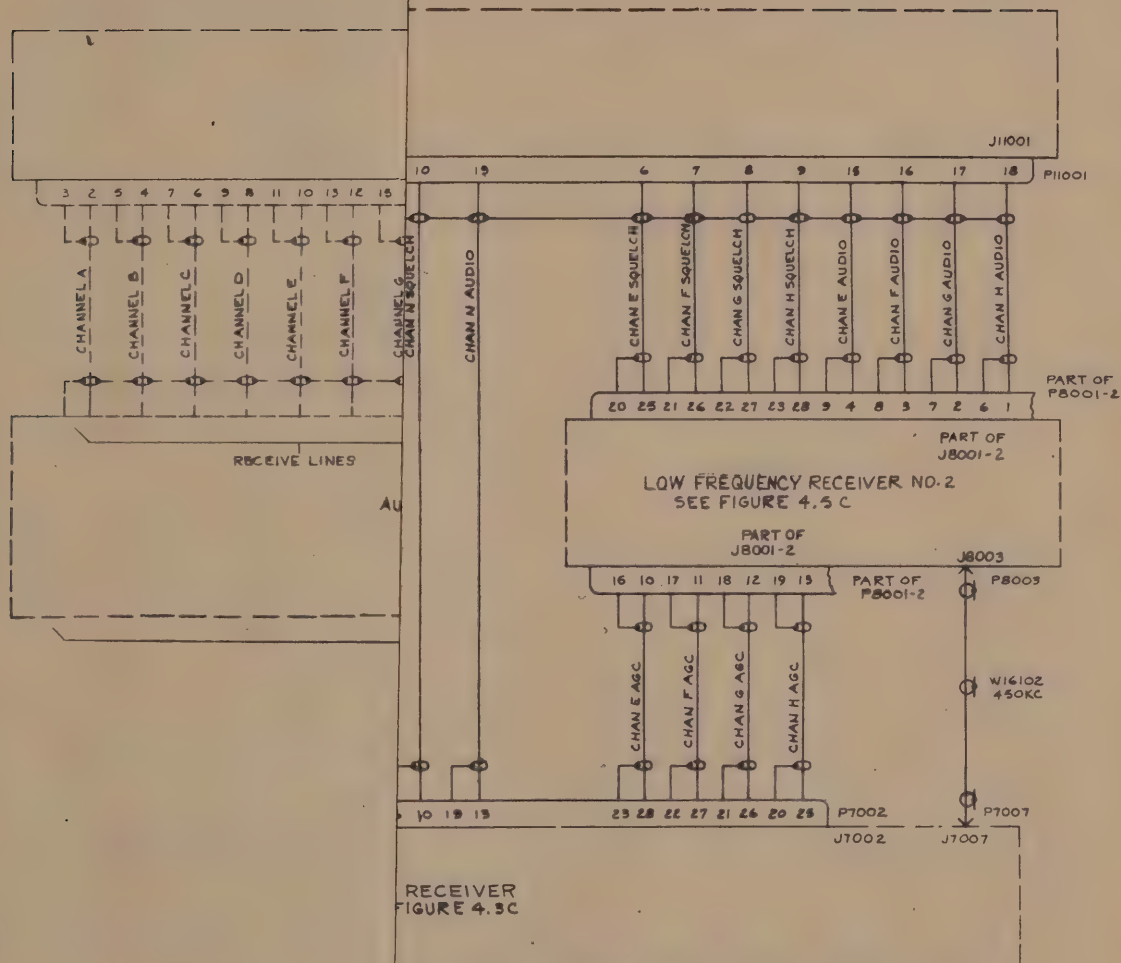


Figure 36. Radio Central Automatic Dialing Translation Equipment, Operational Block Diagram (Single Channel)



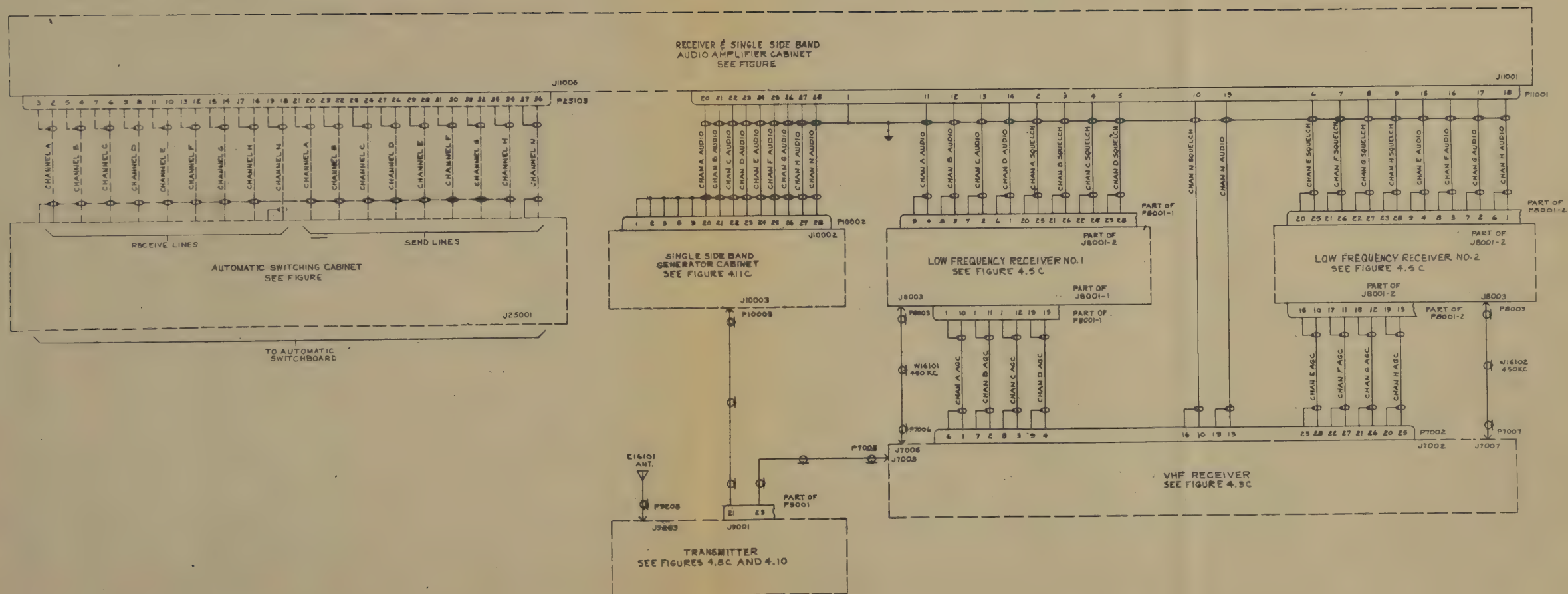


Figure 37. Interconnecting Diagram, Intracabinet
Signal Radio Central Equipment

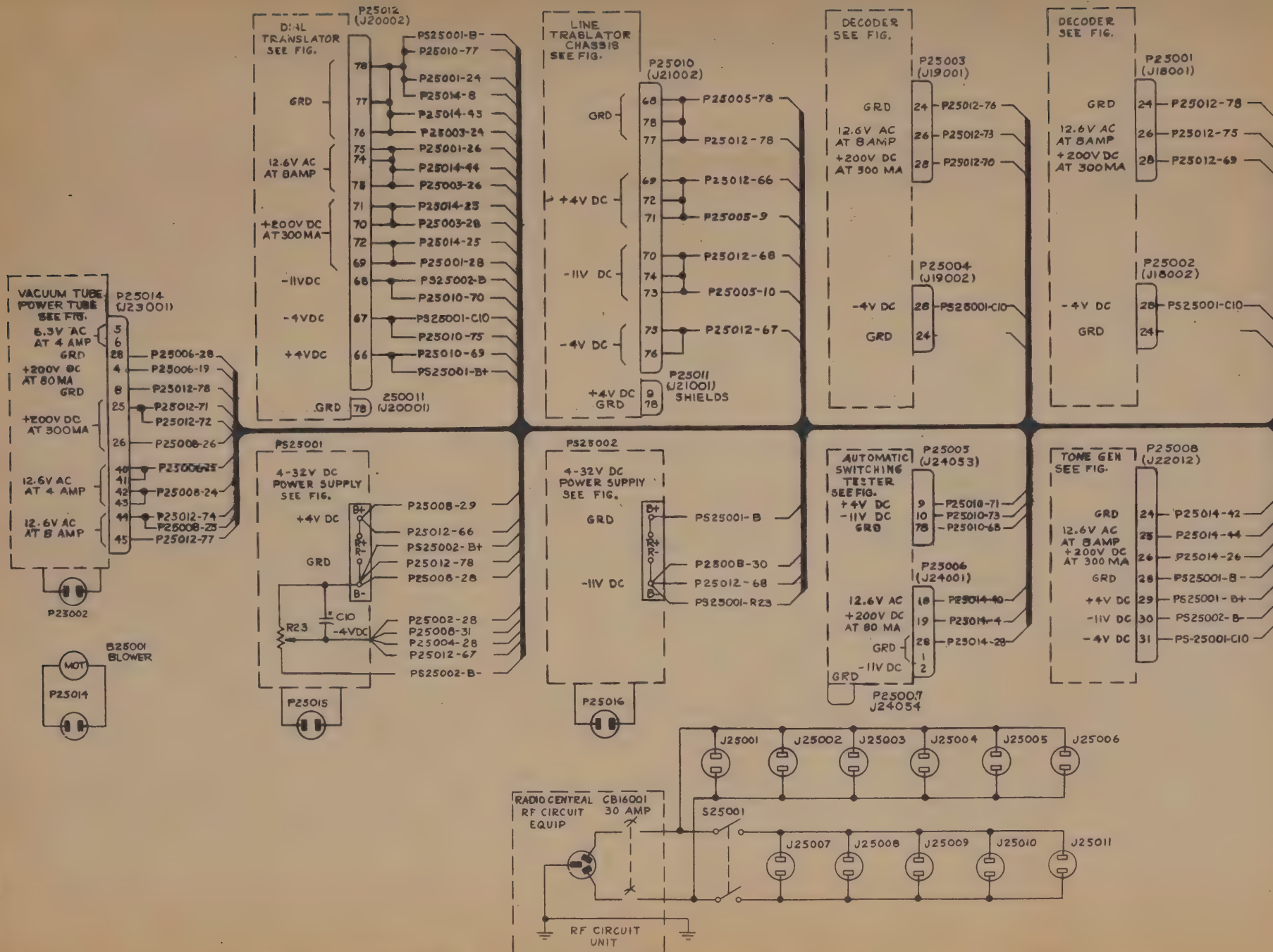
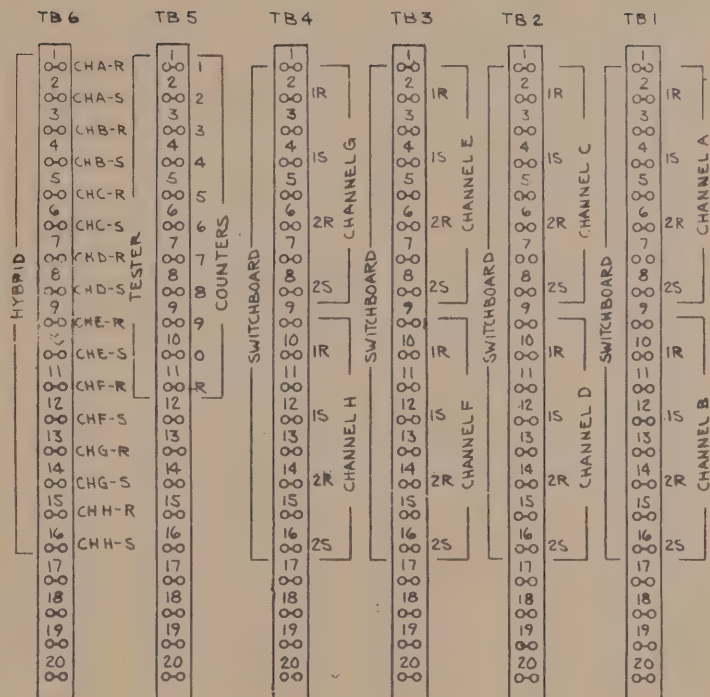
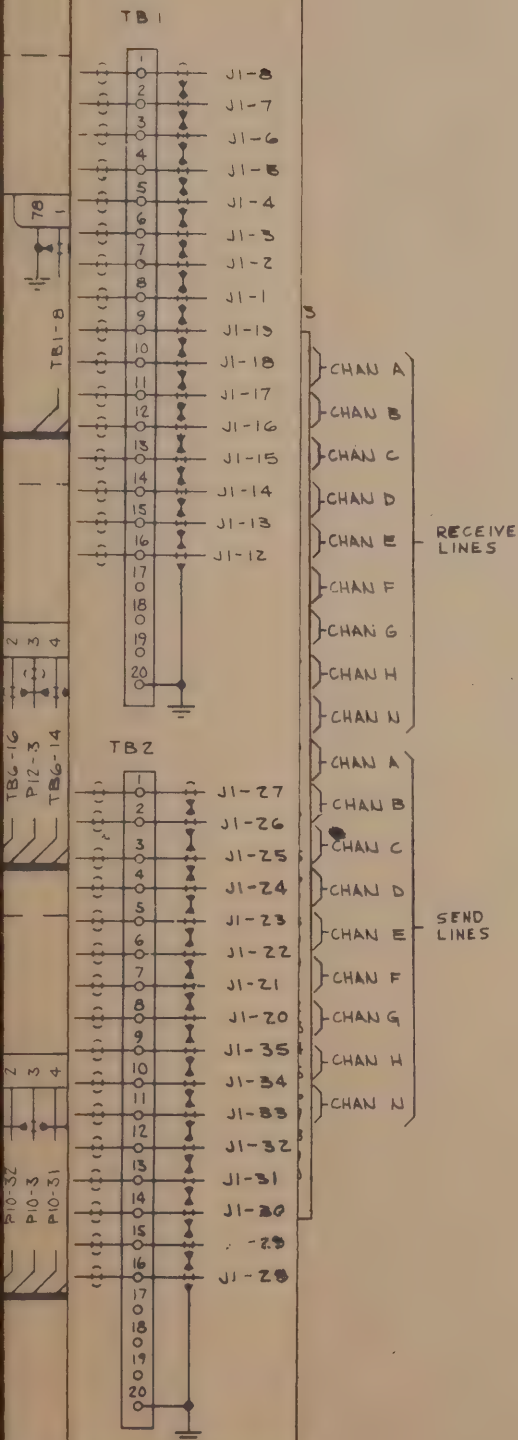


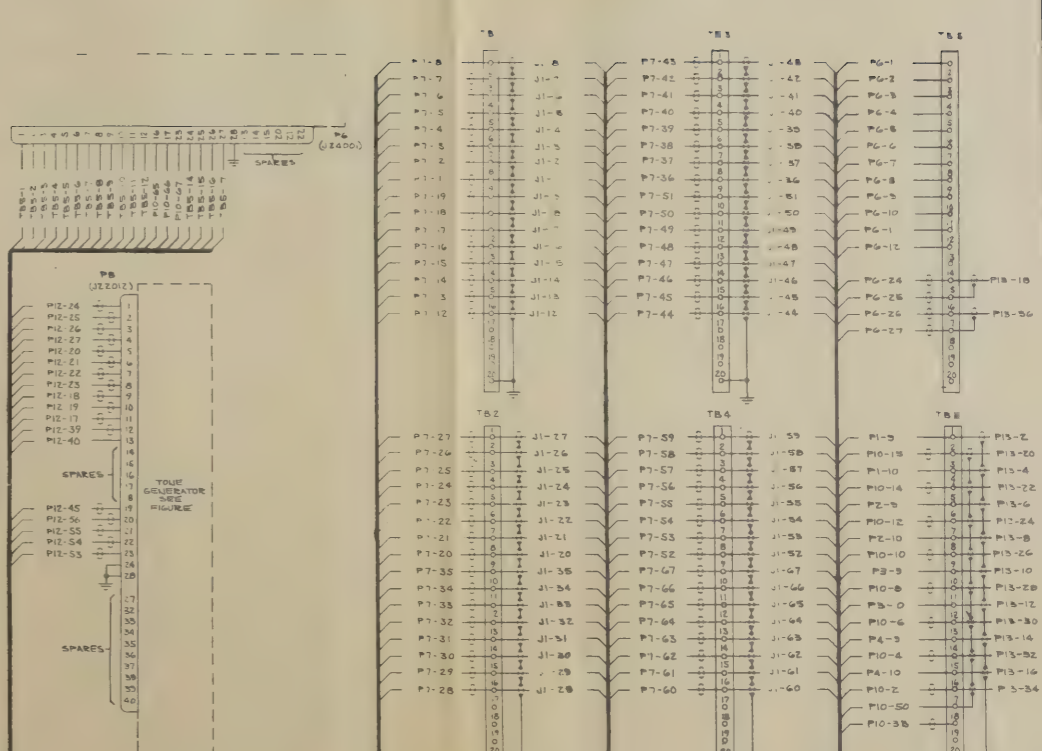
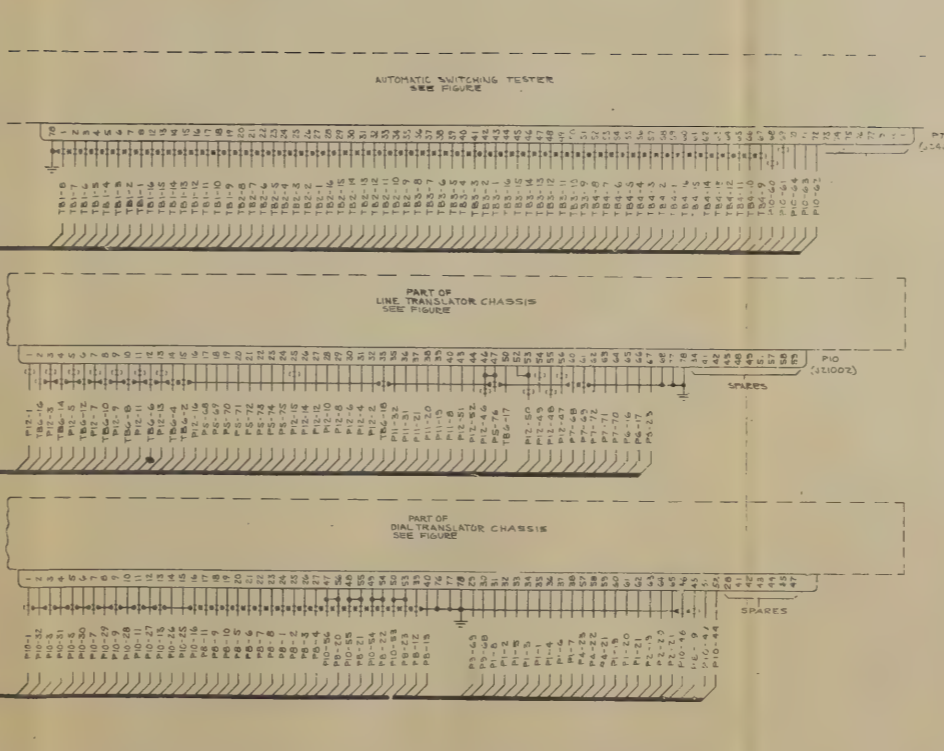
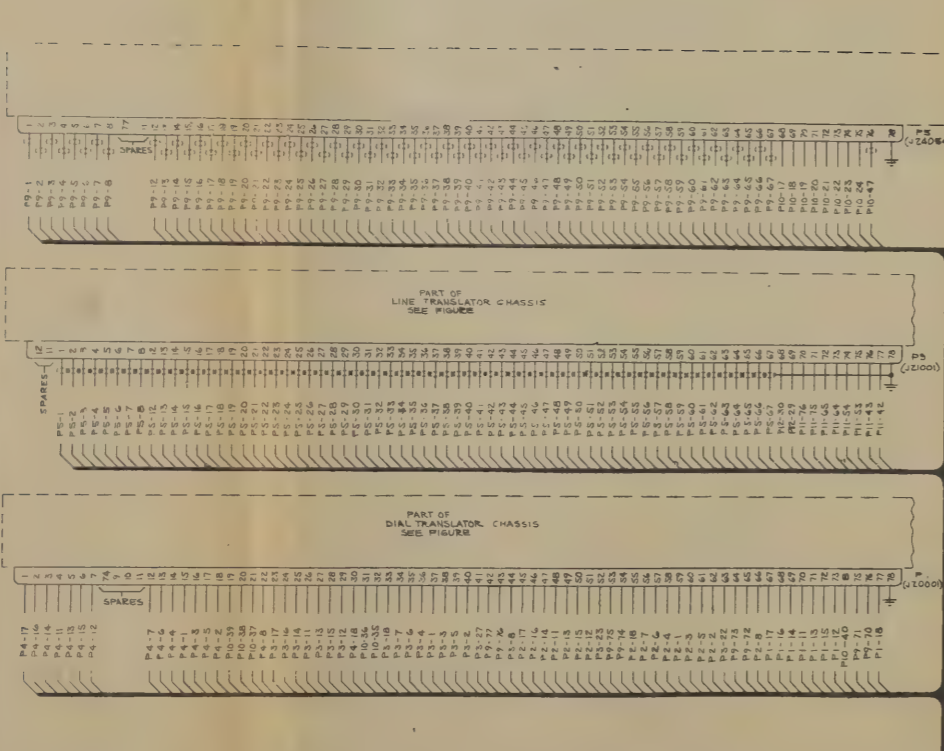
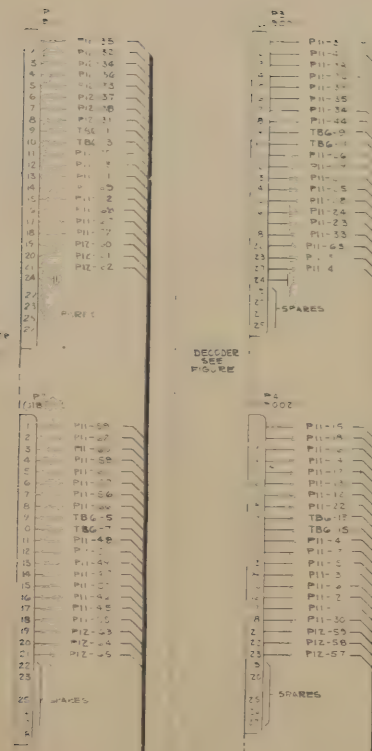
Figure 38. Translation Equipment Intracabinet Cabling Diagram (Power)



DETAIL "A"
(SEE NOTE 2)

NOTES

1. REFERENCE DESIGNATIONS ARE ABBREVIATED. ADD (500) TO REFERENCE NUMBERS.
2. DETAIL "A" SHOWS TERMINAL BOARD MARKING. TB NUMBERS AND TERMINAL NUMBERS ARE ARBITRARILY ASSIGNED AND ARE FOR REFERENCE ONLY.



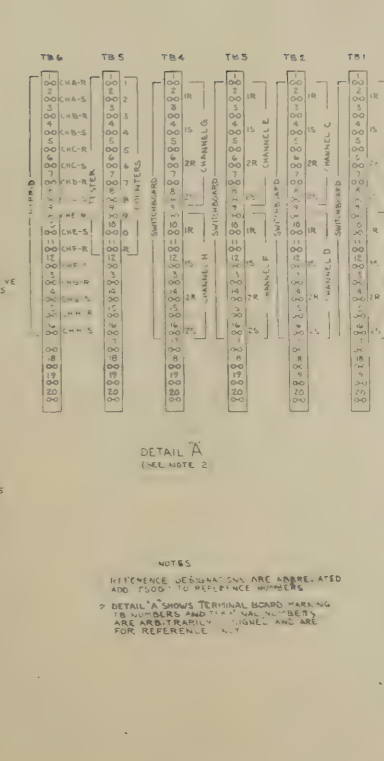
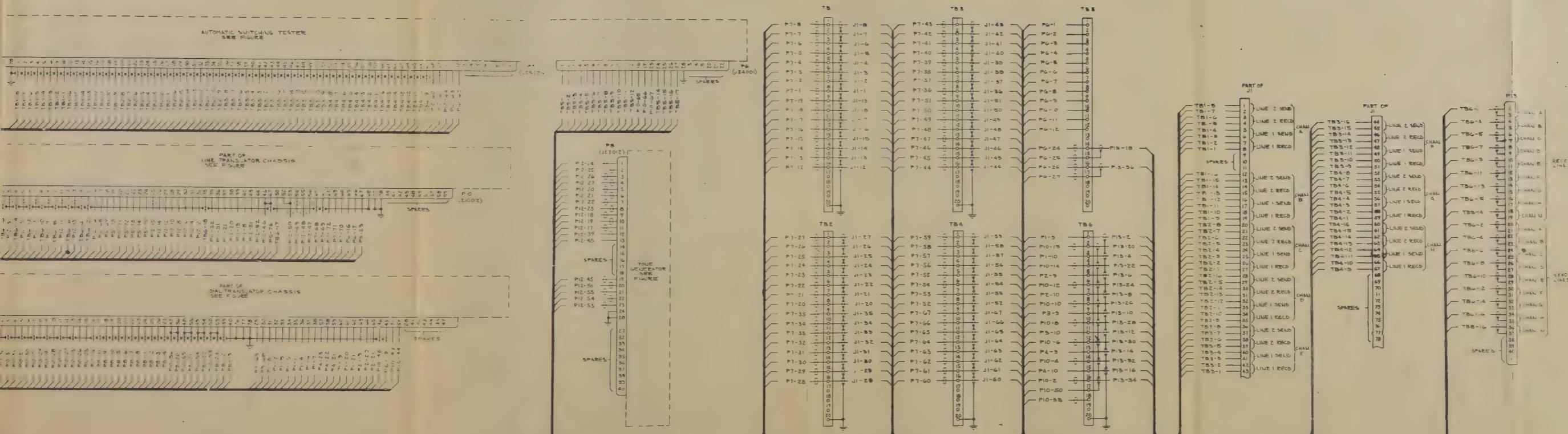


Figure 30. Translation Equipment Interconnection Cabling Diagram (Signaling)

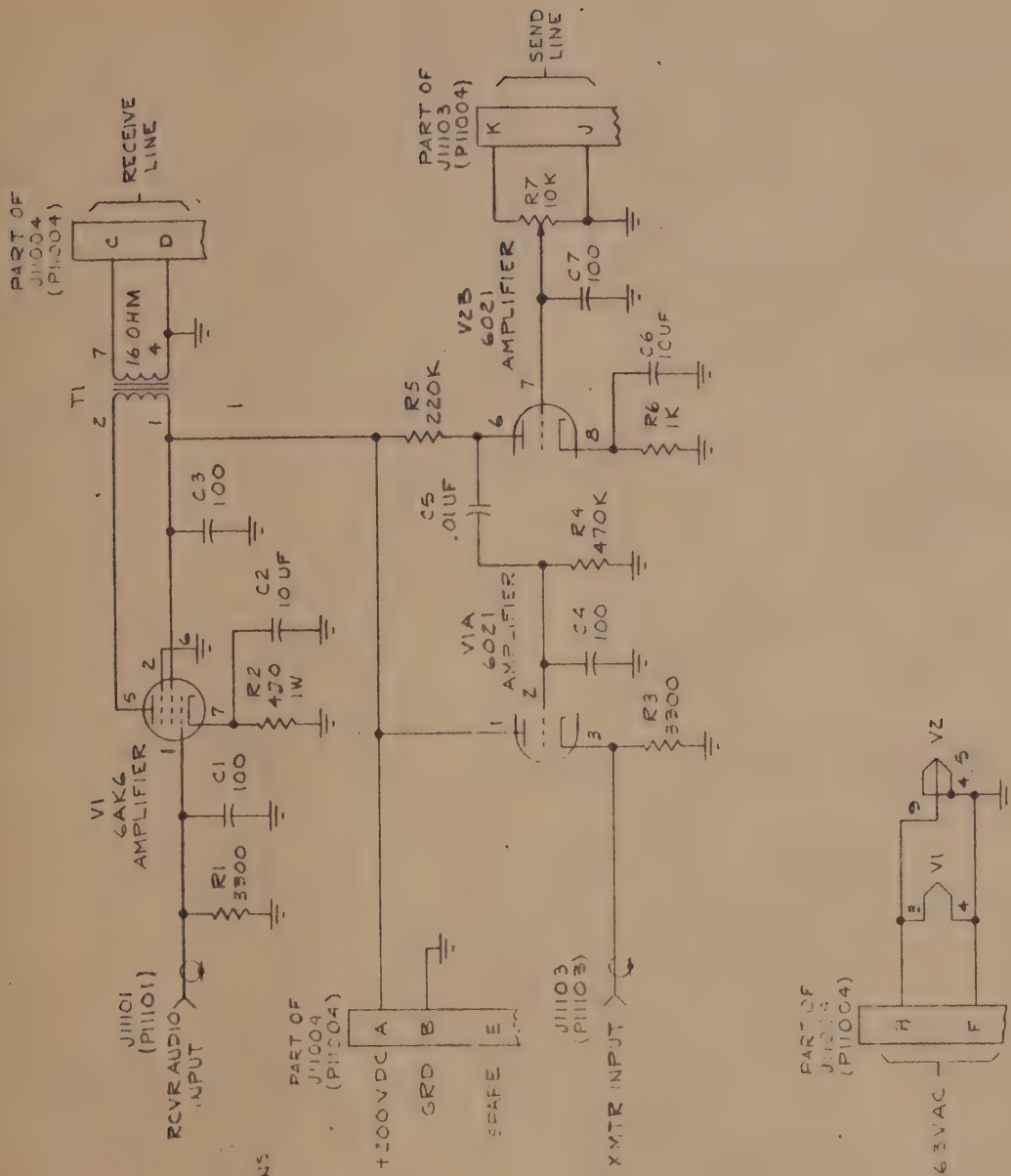
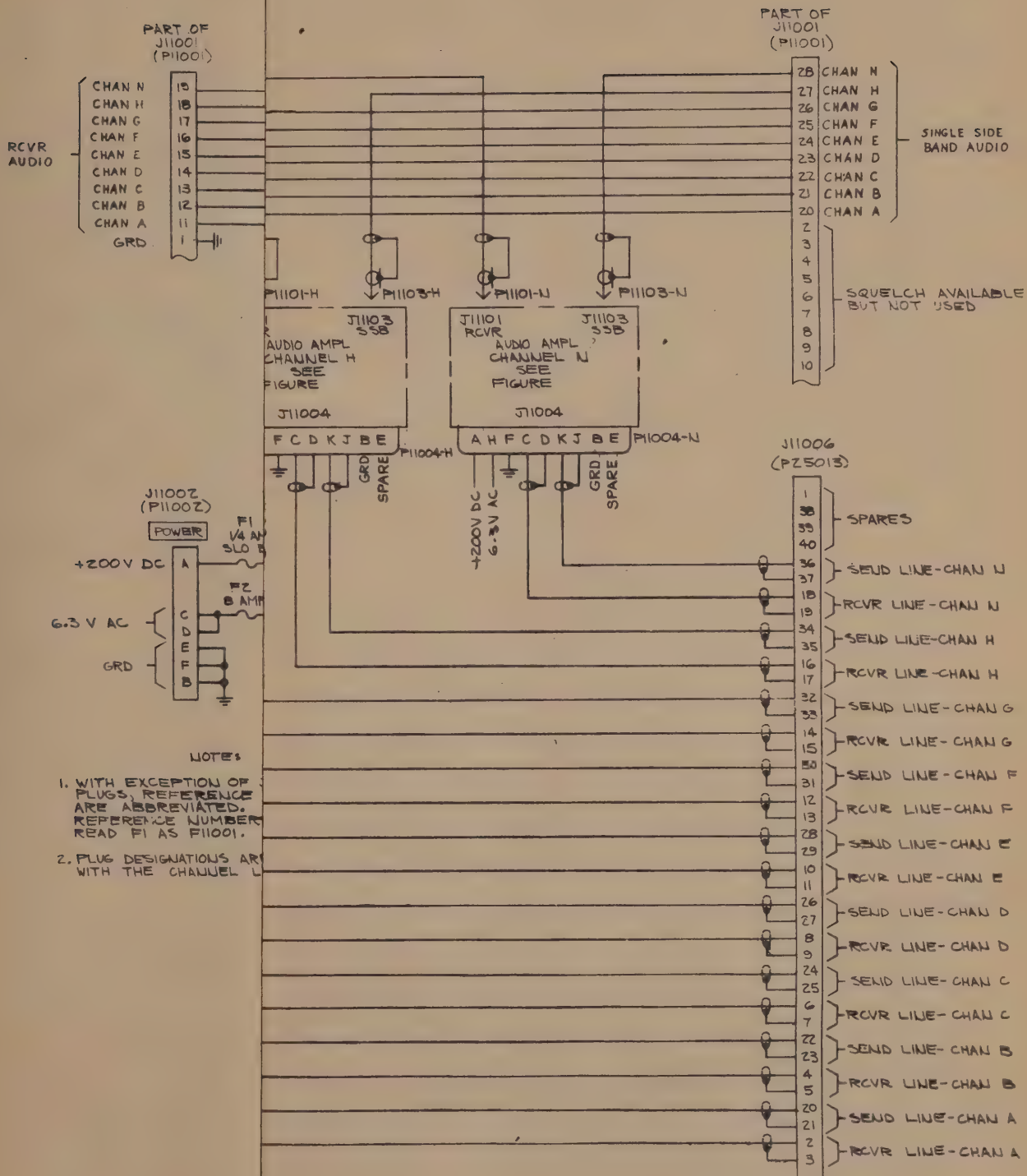


Figure 40. Receiver And SSB Audio Amplifier Schematic Diagram



41. Receiver And SSB Generator Audio Amplifier Cabinet, Cabling Diagram

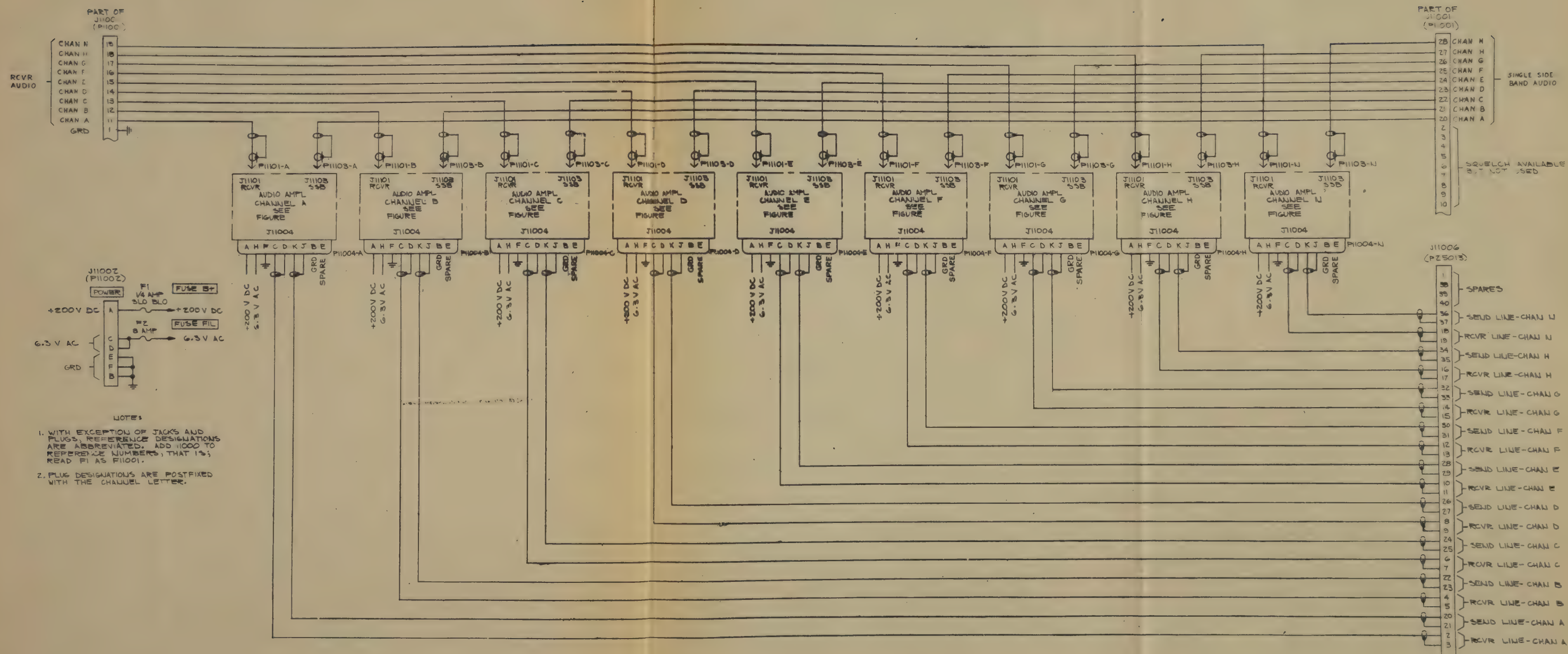


Figure 41. Receiver And SSB Generator Audio Amplifier Cabinet, Cabling Diagram

NOTES:

1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS ARE IN OHMS.
ALL CAPACITORS ARE IN μ F.

2. DECODER STAGES 1 THRU 8 ARE
SCHEMATICALLY IDENTICAL AS
SHOWN IN DETAIL "A". REFERENCE
DESIGNATIONS ARE OBTAINED
BY POSTFIXING A HYPERH4 THE
APPROPRIATE STAGE NUMBER TO
REFERENCE DESIGNATIONS.

3. NUMBERS ON THE INPUT/OUTPUT
LEADS OF DETAIL "A" ARE ARBITRARILY
ASSIGNED & CORRESPOND TO THE
NUMBERS OF THE INPUT/OUTPUT
OF CHANNELS A THRU H.

4. WITH EXCEPTION OF JACKS,
REFERENCE DESIGNATIONS ARE
ABBREVIATED FOR STAGES 1
THRU 4 ADD 18000, FOR
STAGES 5 THRU 8 ADD
19000.

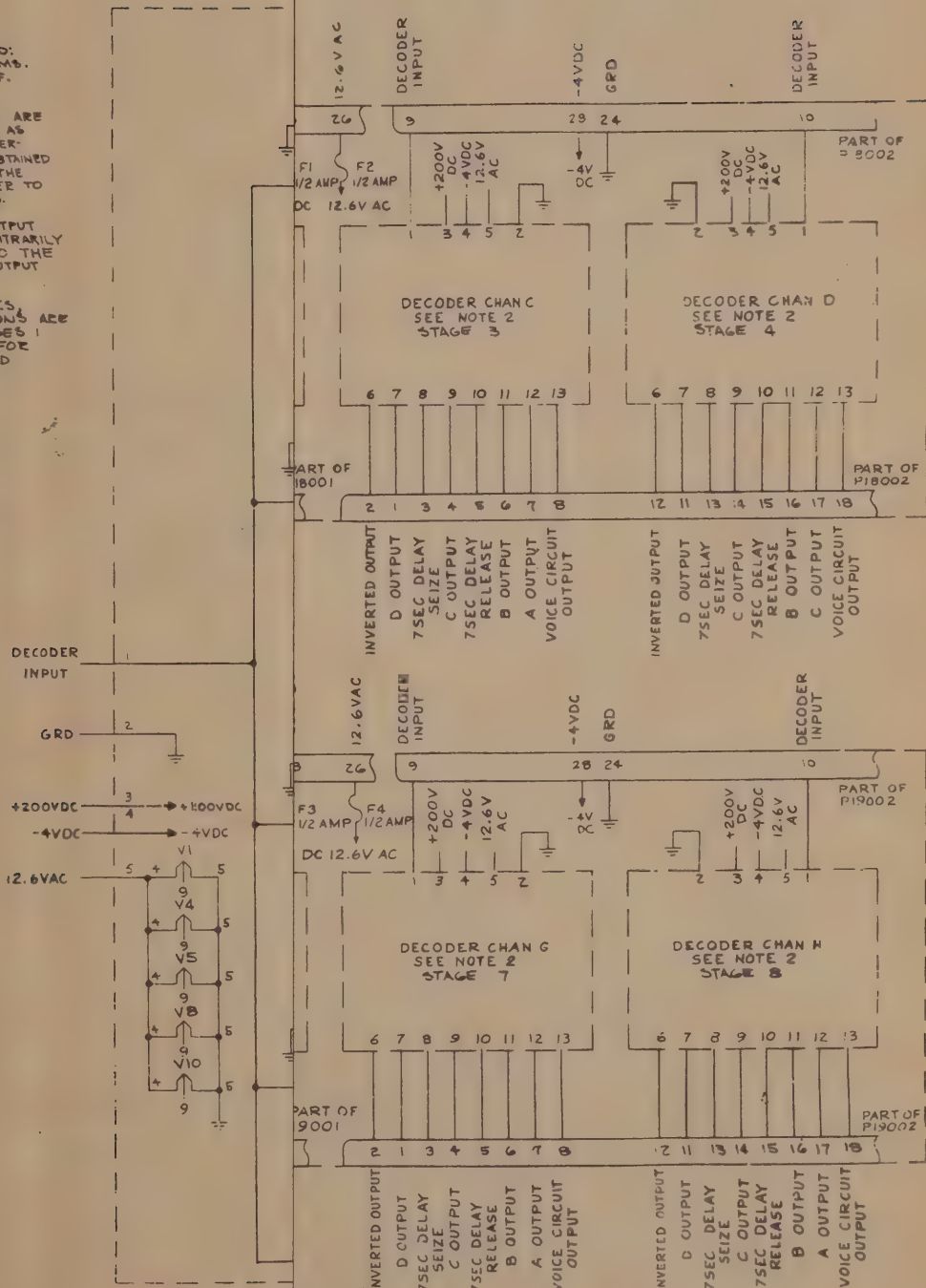


Figure 42. Central Station Decoder Chassis, Schematic Diagram

NOTES:
1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS ARE IN OHMS.
ALL CAPACITORS ARE IN UF.

2. DECODER STAGES 1 THRU 8 ARE SCHEMATICALLY IDENTICAL AS SHOWN IN DETAIL 'A'. REFERENCE DESIGNATIONS ARE OBTAINED BY POSTFIXING A HYPHEN & THE APPROPRIATE STAGE NUMBER TO REFERENCE DESIGNATIONS.

3. NUMBERS ON THE INPUT/OUTPUT LEADS OF DETAIL 'A' ARE ARBITRARILY ASSIGNED & CORRESPOND TO THE NUMBERS OF THE INPUT/OUTPUT OF CHANNELS A THRU H.

4. WITH EXCEPTION OF JACKS, REFERENCE DESIGNATIONS ARE ABBREVIATED FOR STAGES 1 THRU 4: ADD 'B000' FOR STAGES 5 THRU 8: ADD '1900'.

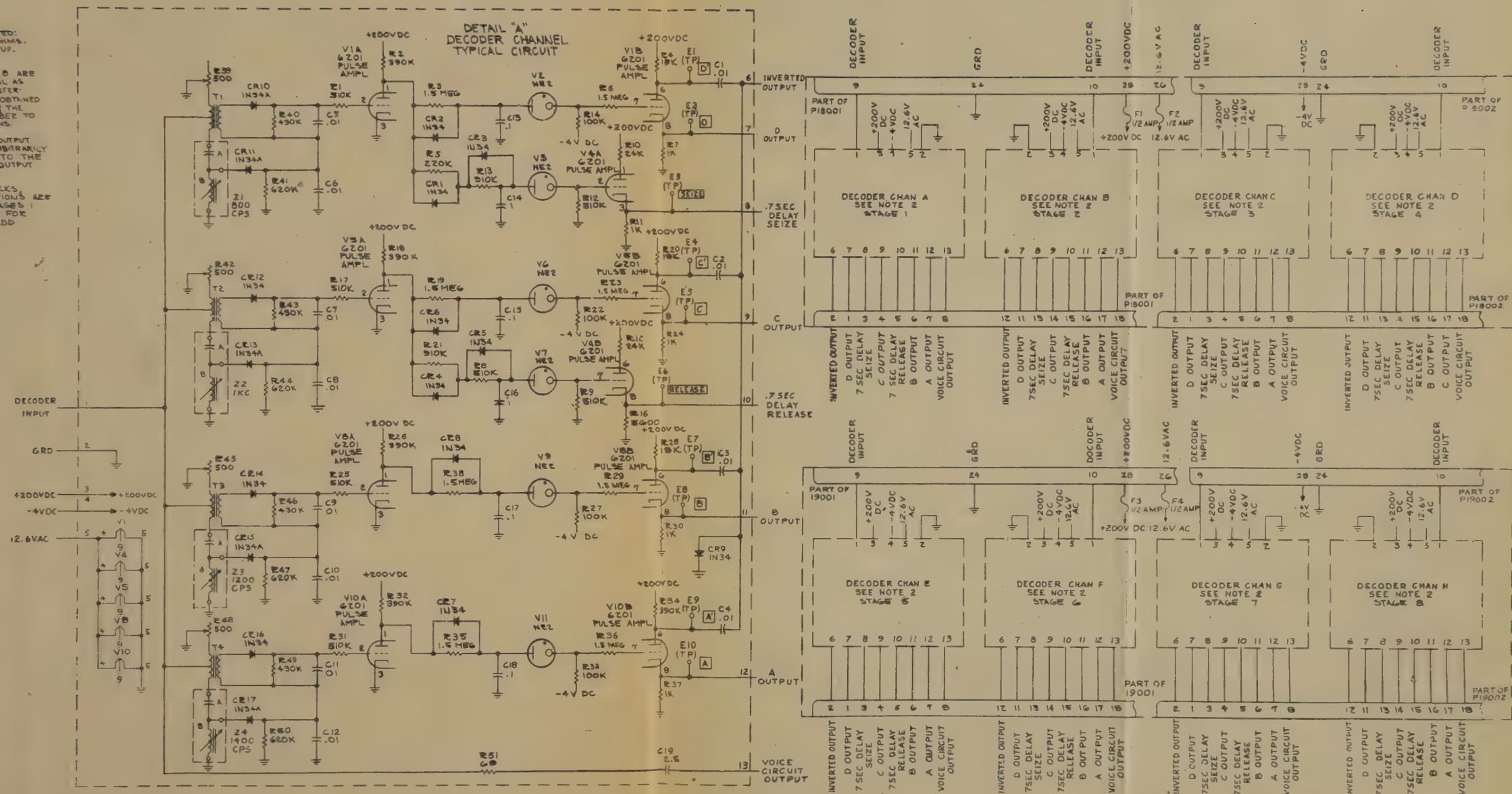
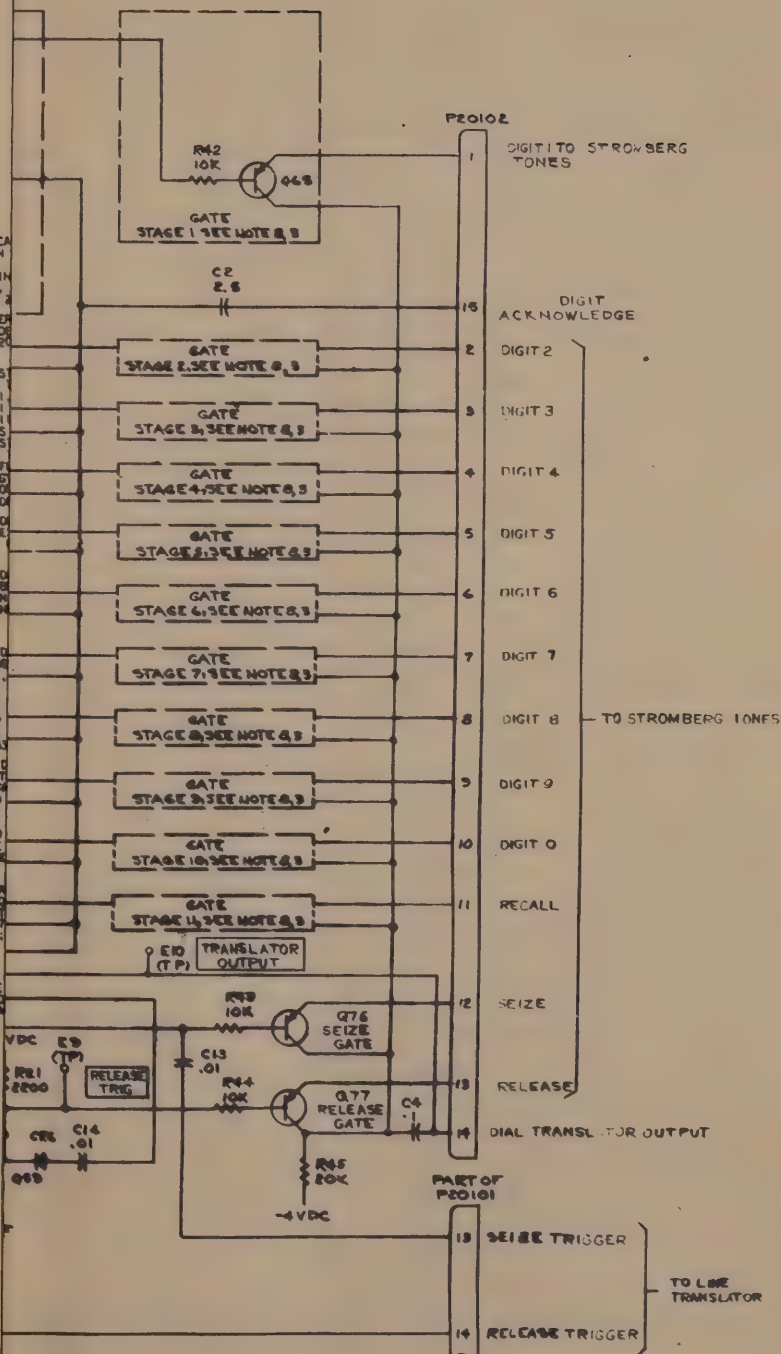


Figure 42. Central Station Decoder Chassis, Schematic Diagram

1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN 1/2 WATT, ALL CAPACITORS ARE IN 100 P.F., ALL DIODES ARE 1N34A, ALL TRANSISTORS ARE 2N434A.
2. WITH EXCEPTION OF EXTERIOR PLUGS, REFERENCE DESIGNATIONS ARE ABBREVIATED: ADD 20 TO REFERENCE NUMBERS.
3. TIMING MULTIVIBRATOR STAGE 5, AMPLIFIER STAGES 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.
4. TRANSISTOR REFERENCE DESIGNATION IN THE AMPLIFIER STAGE IS: 1, AS SHOWN; STAGE 2, Q7; STAGE 4, Q10.
5. TRANSISTOR REFERENCE DESIGNATION IN THE TIMING MULTIVIBRATOR ARE: STAGE 1, AS SHOWN; STAGE 2, Q8; STAGE 3, Q9; STAGE 4, Q11; STAGE 5, Q12.
6. TRANSISTOR REFERENCE DESIGNATION IN THE "AND GATE" STAGE IS: 1, AS SHOWN; STAGE 2, Q13; STAGE 3, Q14; STAGE 4, Q15; STAGE 5, Q16; STAGE 6, Q17; STAGE 7, Q18; STAGE 8, Q19; STAGE 9, Q20; STAGE 10, Q21; STAGE 11, Q22.
7. TRANSISTOR REFERENCE DESIGNATION IN THE MULTIVIBRATOR STAGE IS: 1, AS SHOWN; STAGE 2, Q23; STAGE 3, Q24; STAGE 4, Q25; STAGE 5, Q26; STAGE 6, Q27; STAGE 7, Q28; STAGE 8, Q29; STAGE 9, Q30; STAGE 10, Q31; STAGE 11, Q32.
8. TRANSISTOR REFERENCE DESIGNATION IN THE GATE STAGES ARE: STAGE 1, AS SHOWN; STAGE 2, Q33; STAGE 3, Q34; STAGE 4, Q35; STAGE 5, Q36; STAGE 6, Q37; STAGE 7, Q38; STAGE 8, Q39; STAGE 9, Q40; STAGE 10, Q41; STAGE 11, Q42.
9. MARKING ON E7 IS THE STAGE NUMBER FOR EACH OF THE EXCEPTION OF STAGE "RECALL TRIG".



43. Dial Translator (Single Channel), Schematic Diagram

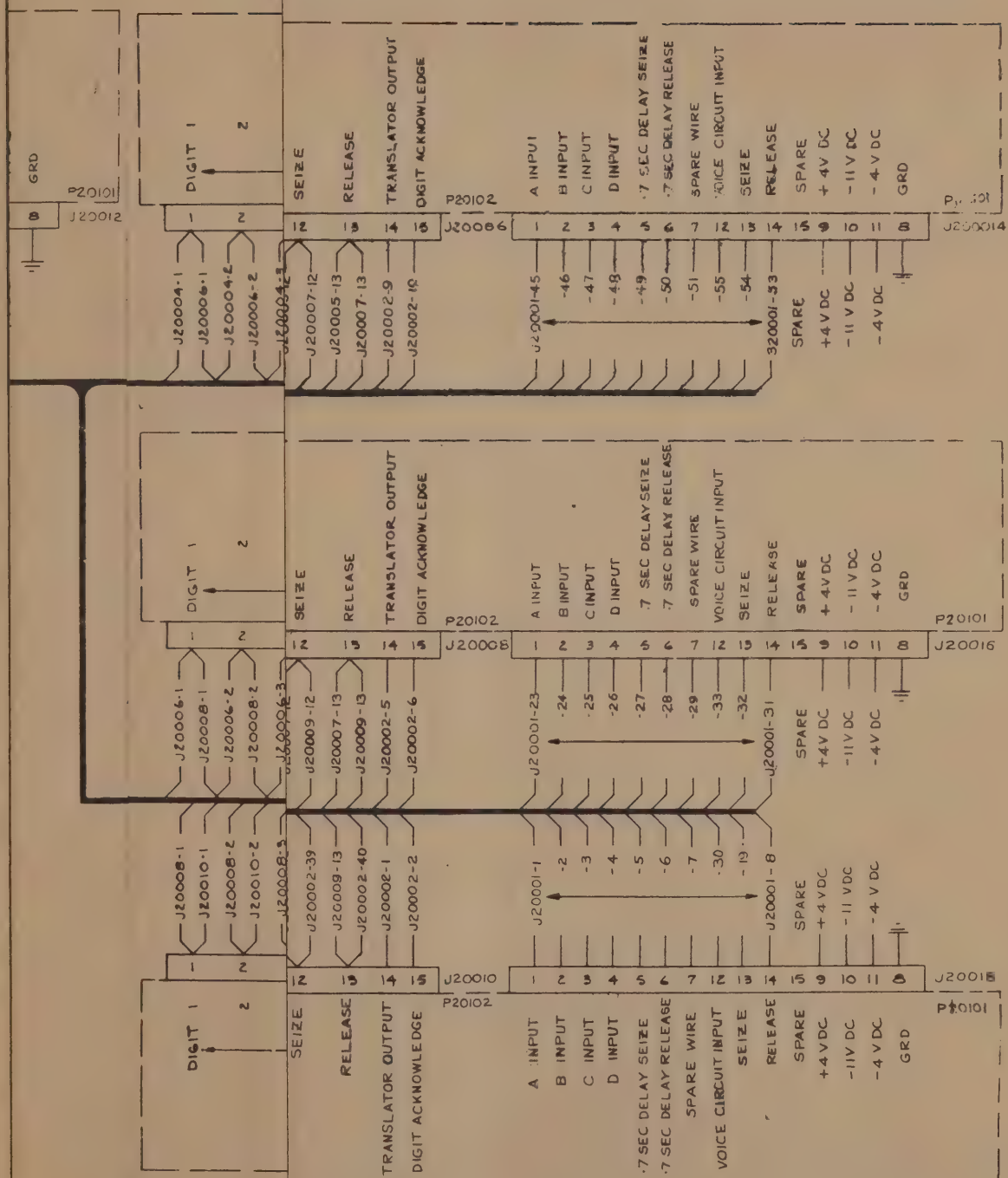


Figure 44. Dial Translator Intrachassis Cabling Diagram

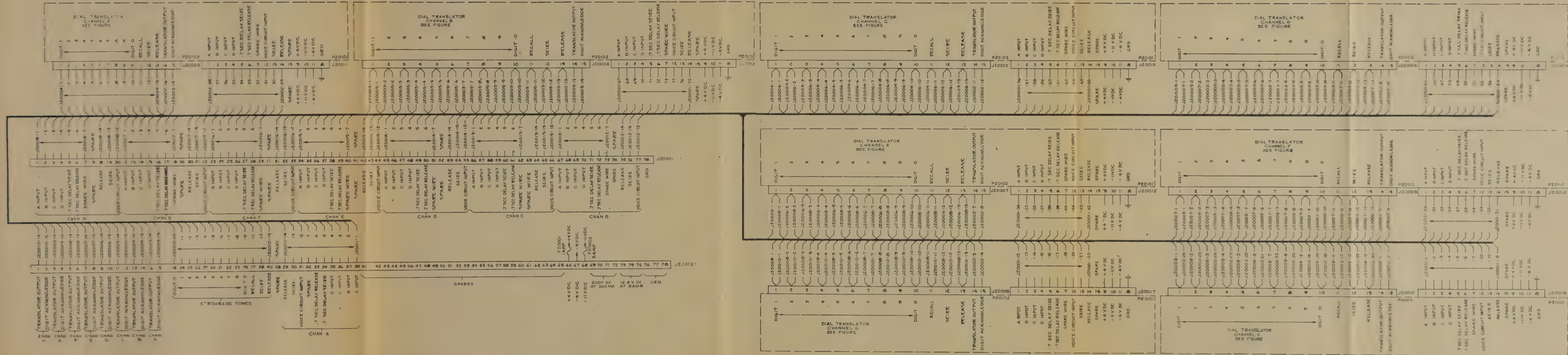


Figure 4. Dial Translator Intrachassis Cabling Diagram

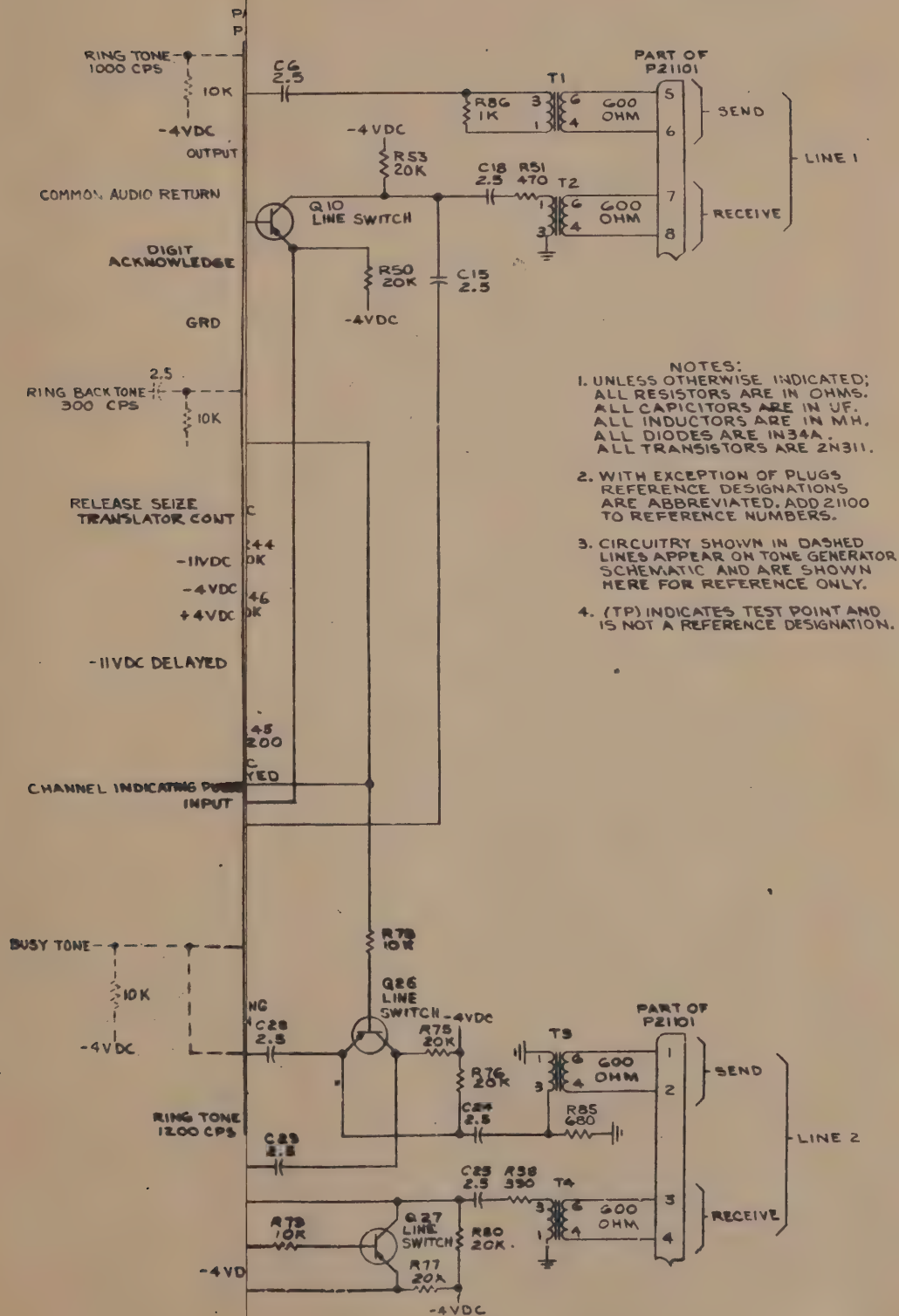


Figure 45. Line Translator (Single Channel), Schematic Diagram

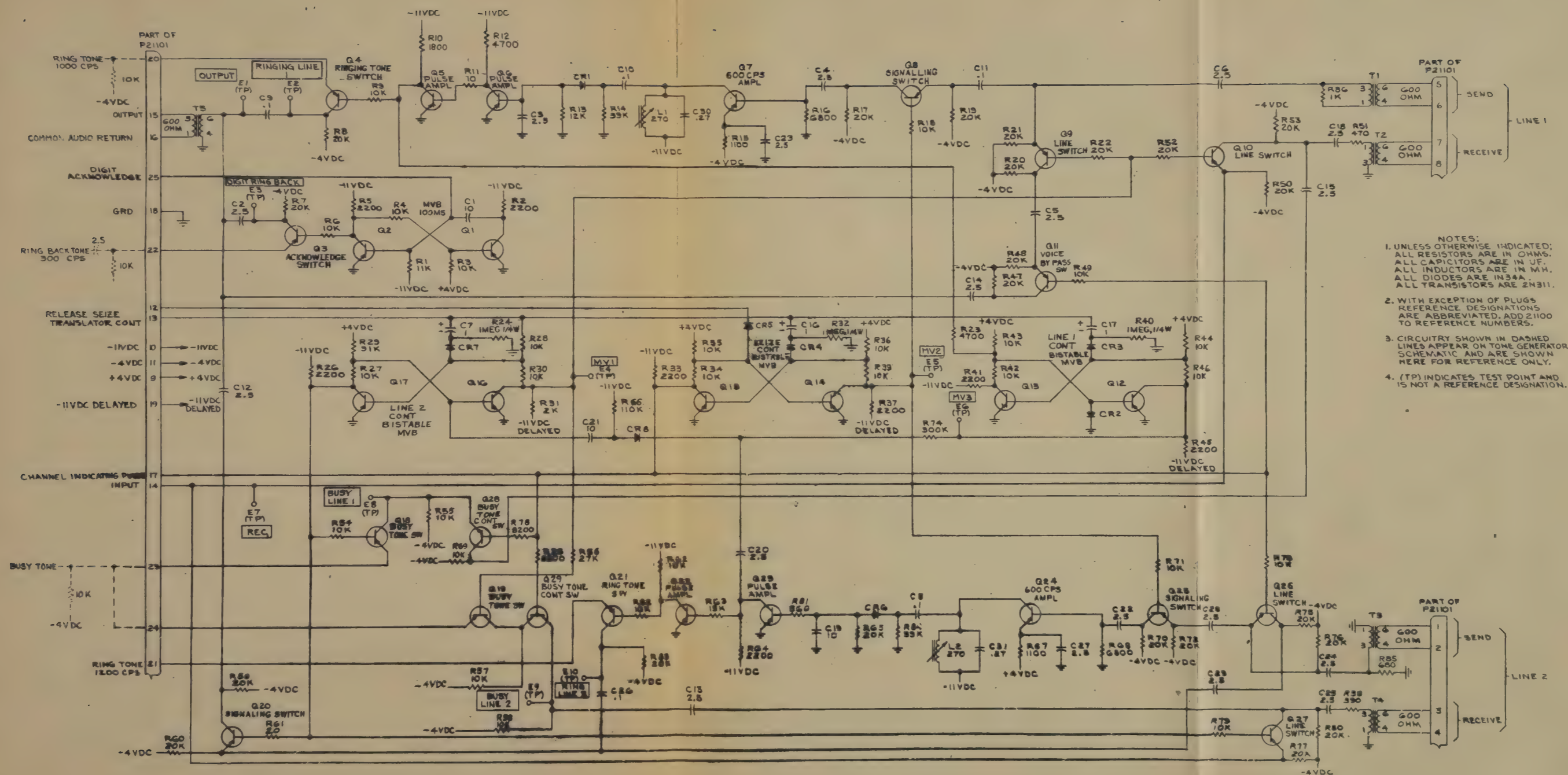


Figure 45. Line Translator (Single Channel), Schematic Diagram

MANUAL
RESET

S2 006

J2101H-19

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

J2101H-9

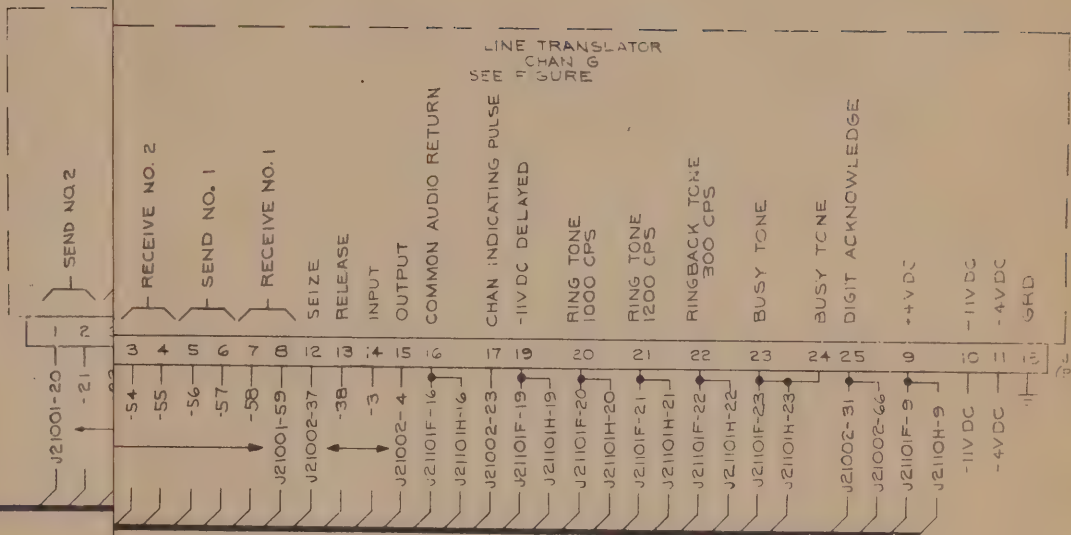
J2101H-9

J2101H-9

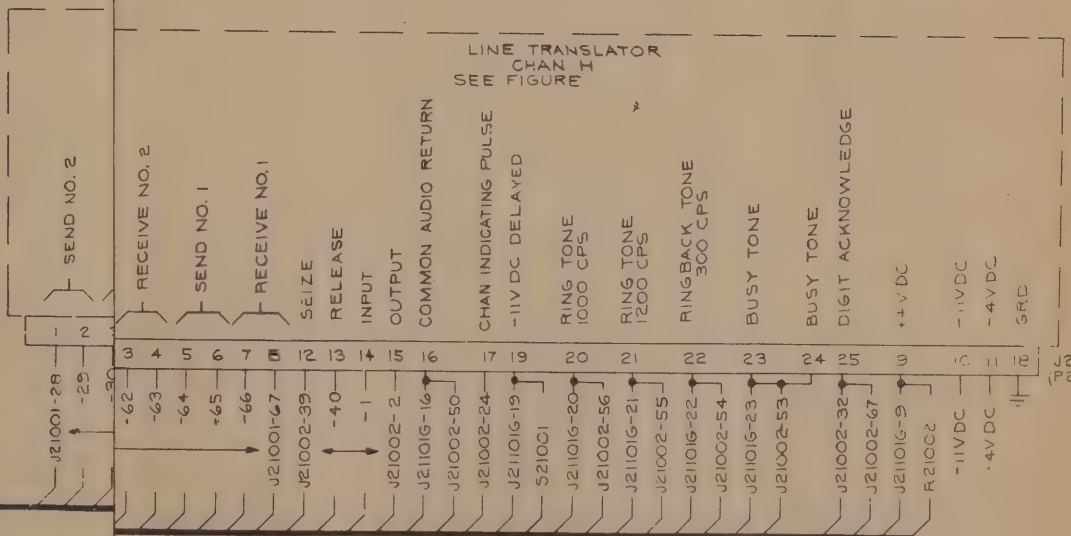
J2101H-9

J2101H-9

J2101H-9



J2101H
(P2101H)



J2101H
(P2101H)

Line Translator Intrachassis Cabling
Diagram

NOTES:
 1. UNLESS OTHERWISE INDICATED
 ALL RESISTORS ARE IN OHMS
 2. 5% TOLERANCE
 ALL CAPACITORS ARE IN MFD
 3. UNLESS OTHERWISE INDICATED
 ALL CAPACITORS ARE IN MFD
 4. UNLESS OTHERWISE INDICATED
 ALL CAPACITORS ARE IN MFD

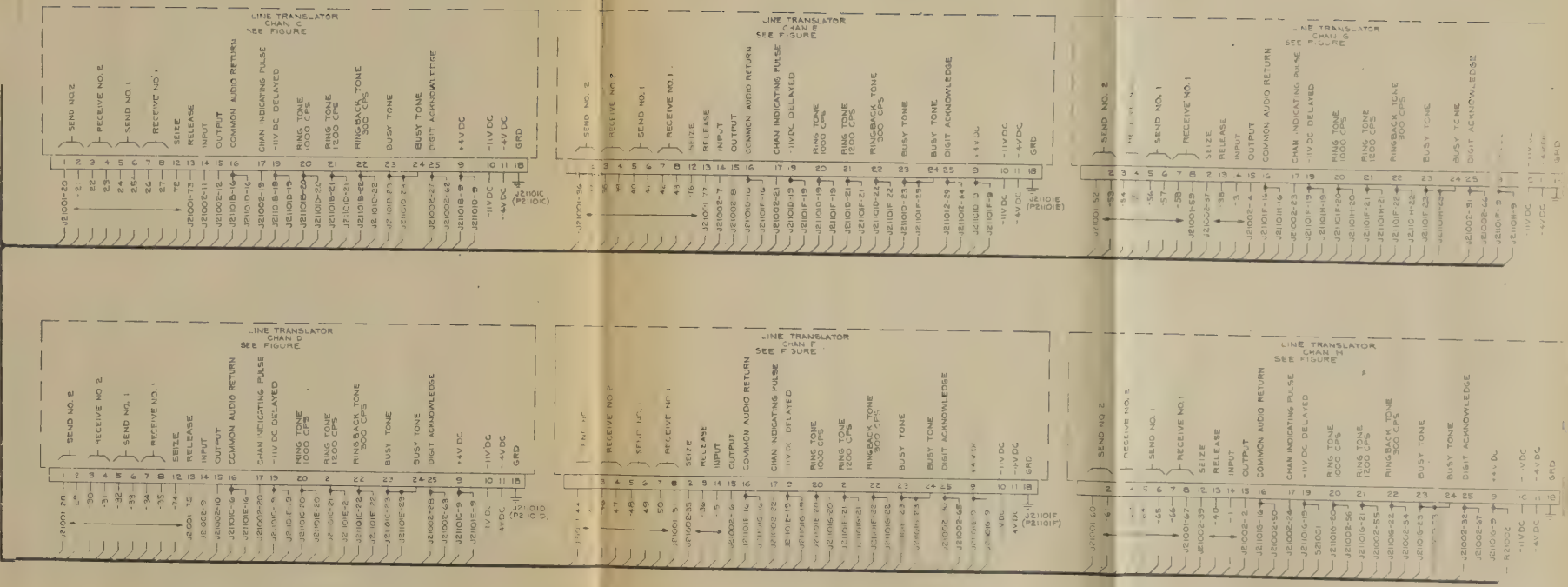
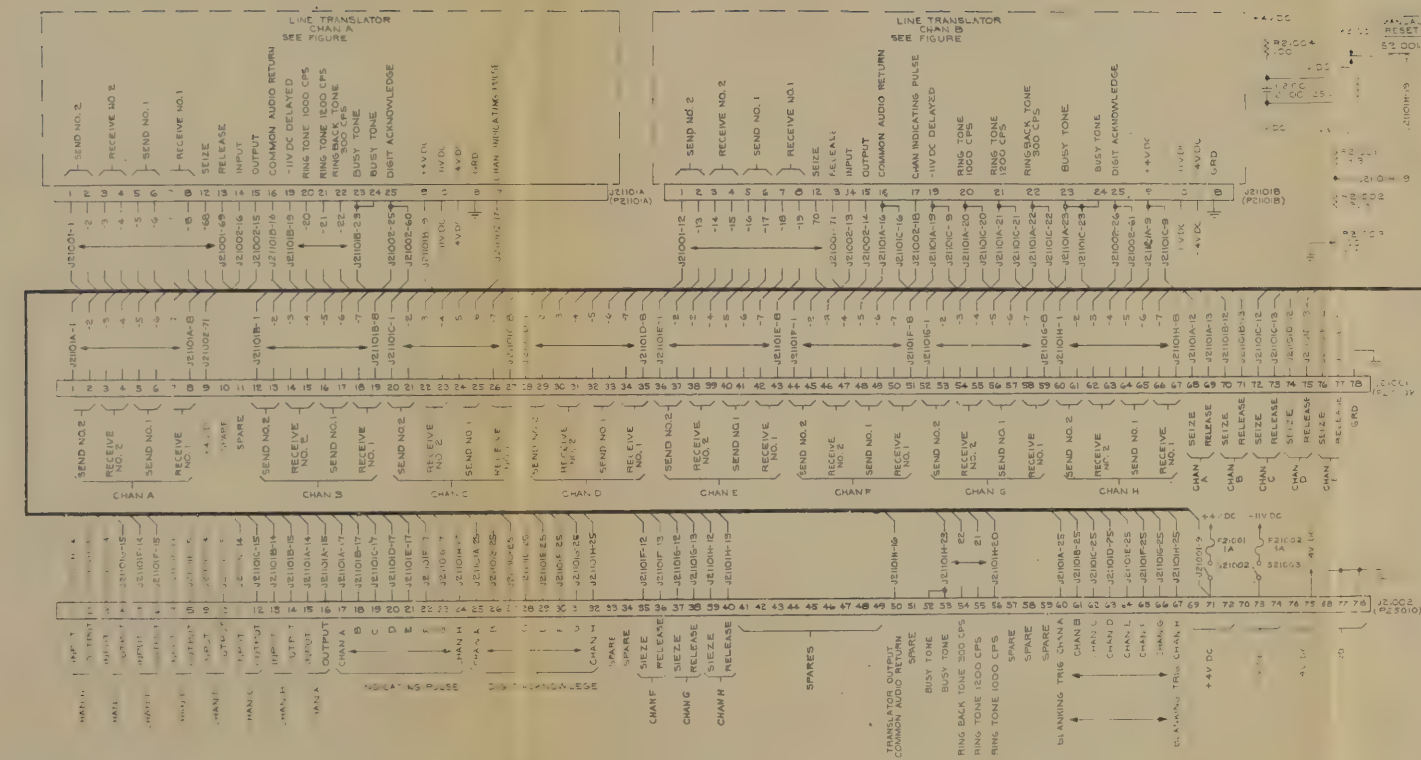


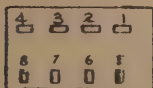
Figure 13. Line Translator Intrachassis Cabling Diagram

NOTES:
 1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN OHMS, 1/2 WATT.
 ALL CAPACITORS ARE IN MICROFARADS.

2. WITH EXCEPTION OF EXTERNAL JACKS, REFERENCE DESIGNATIONS ARE ABBREVIATED. ADD 22 TO REFERENCE NUMBERS.

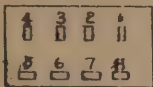
3. PIN NUMBERS ON J22001 TO J22010 ARE ARBITRARILY ASSIGNED AND DO NOT APPEAR ON THE JACKS.

4. TUNED CIRCUIT STAGES 1 THRU 5 MIXER STAGES 1 THRU 12 AND EMITTER FOLLOWER STAGE 1 THRU 8 ARE SCHEMATICAL IDENTICAL AS SHOWN IN STAGE 1 OF EACH RESPECTIVE STAGE. REFERENCE DESIGNATIONS WERE OBTAINED BY POST FIXING A HYPHEN AND THE APPROPRIATE STAGE NUMBER TO REFERENCE DESIGNATIONS.

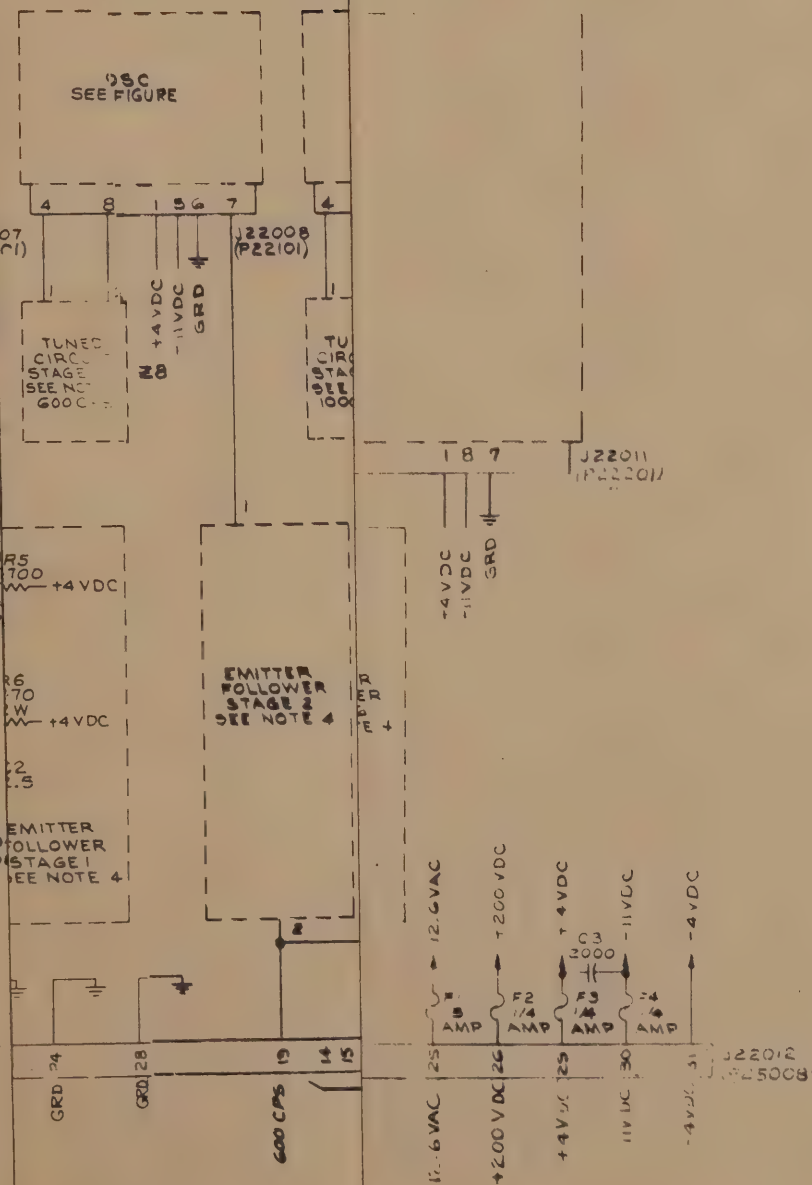


DETAIL OF

J22001, J22002, J22003, J22004, J22005, J22006, J22007, J22008, J22009, J22010.



DETAIL OF
J22011



- NOTES:
1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN OHMS, 5% 1/2 WATT. ALL CAPACITORS ARE IN UF.
 2. WITH EXCEPTION OF EXTERNAL JACKS, REFERENCE DESIGNATIONS ARE ABBREVIATED AND DO NOT APPEAR ON THE JACKS.
 3. PIN NUMBERS ON J22001 THRU J22010 ARE ARBITRARILY ASSIGNED AND DO NOT APPEAR ON THE JACKS.
 4. TUNED CIRCUIT STAGES 1 THRU 10, MIXER STAGES 1 THRU 12 AND EMITTER FOLLOWER STAGES 1 THRU 6 ARE SCHEMATICALLY IDENTICAL AS SHOWN IN STAGE 1 OF EACH RESPECTIVE STAGE REFERENCE DESIGNATIONS WERE OBTAINED BY PUTTING A HYPHEN AND THE APPROPRIATE STAGE NUMBER TO REFERENCE DESIGNATIONS.

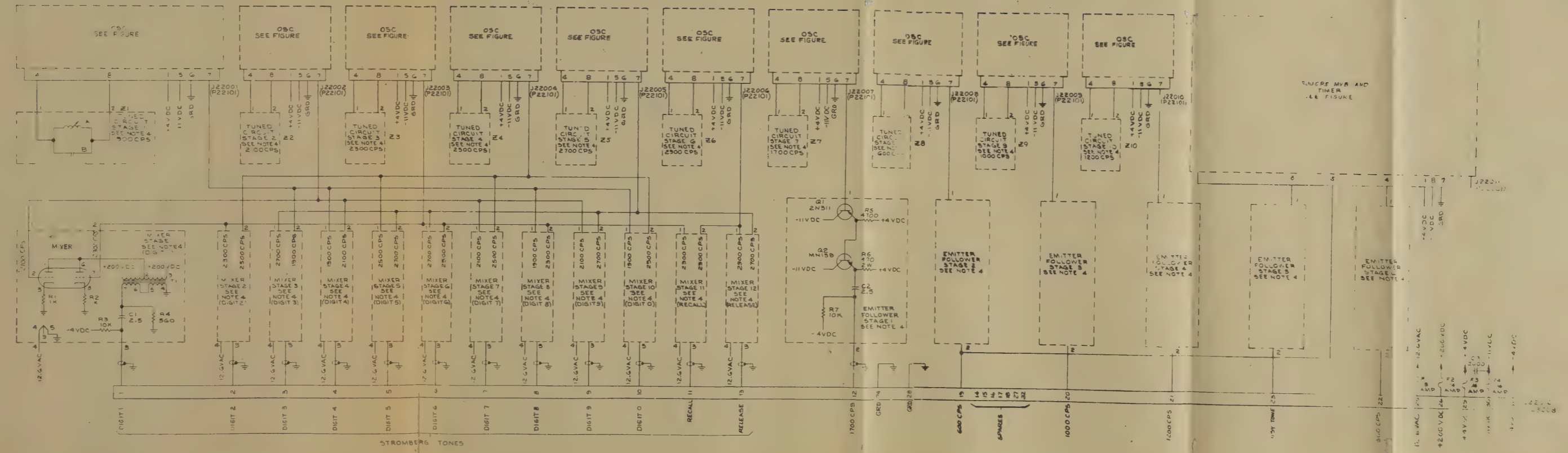
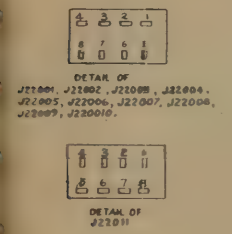
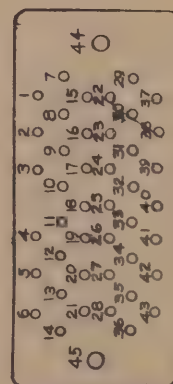


Figure 47. Tone Generator Schematic Diagram



127/128

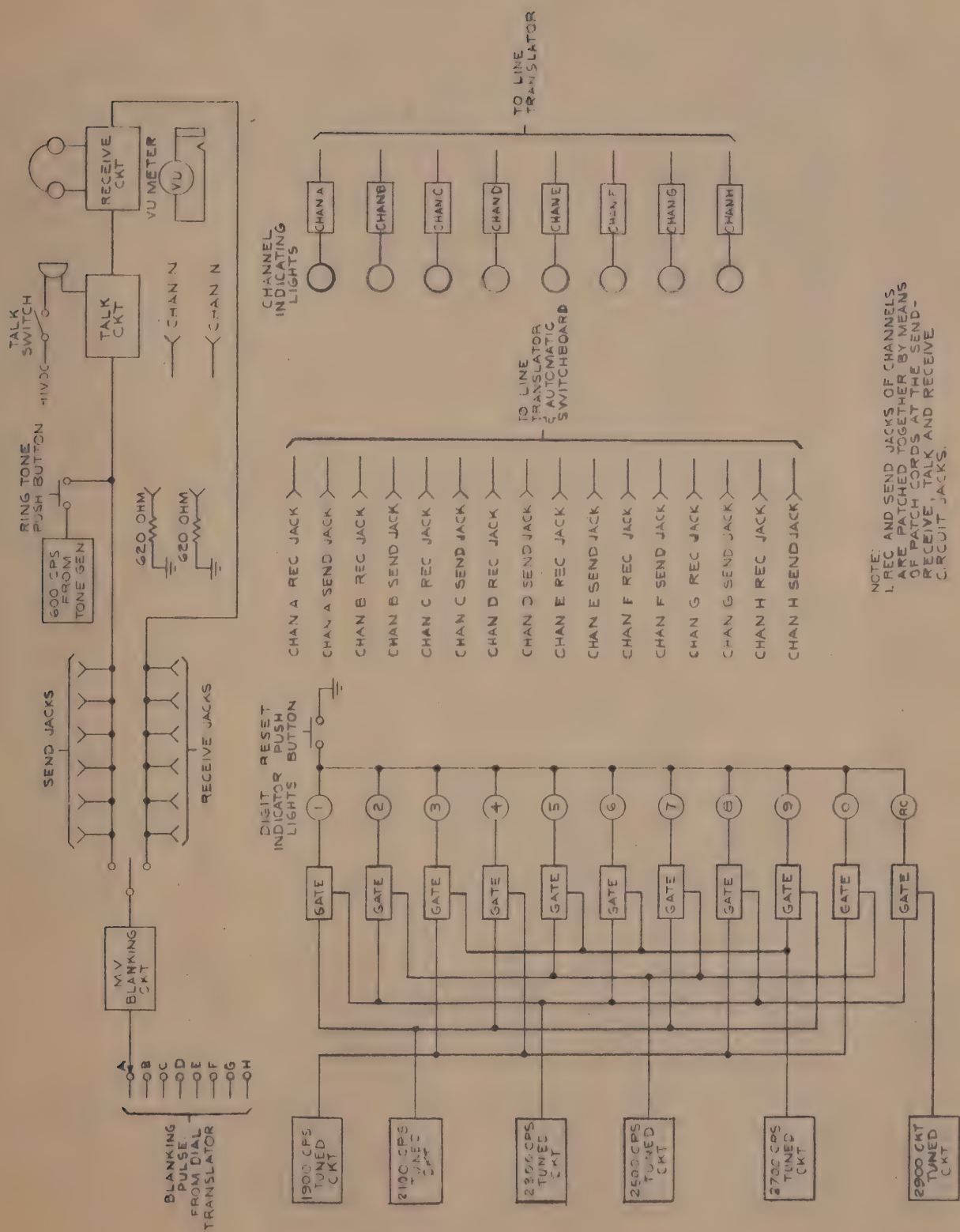


Figure 50. One-Line Manual Switchboard Block-Diagram

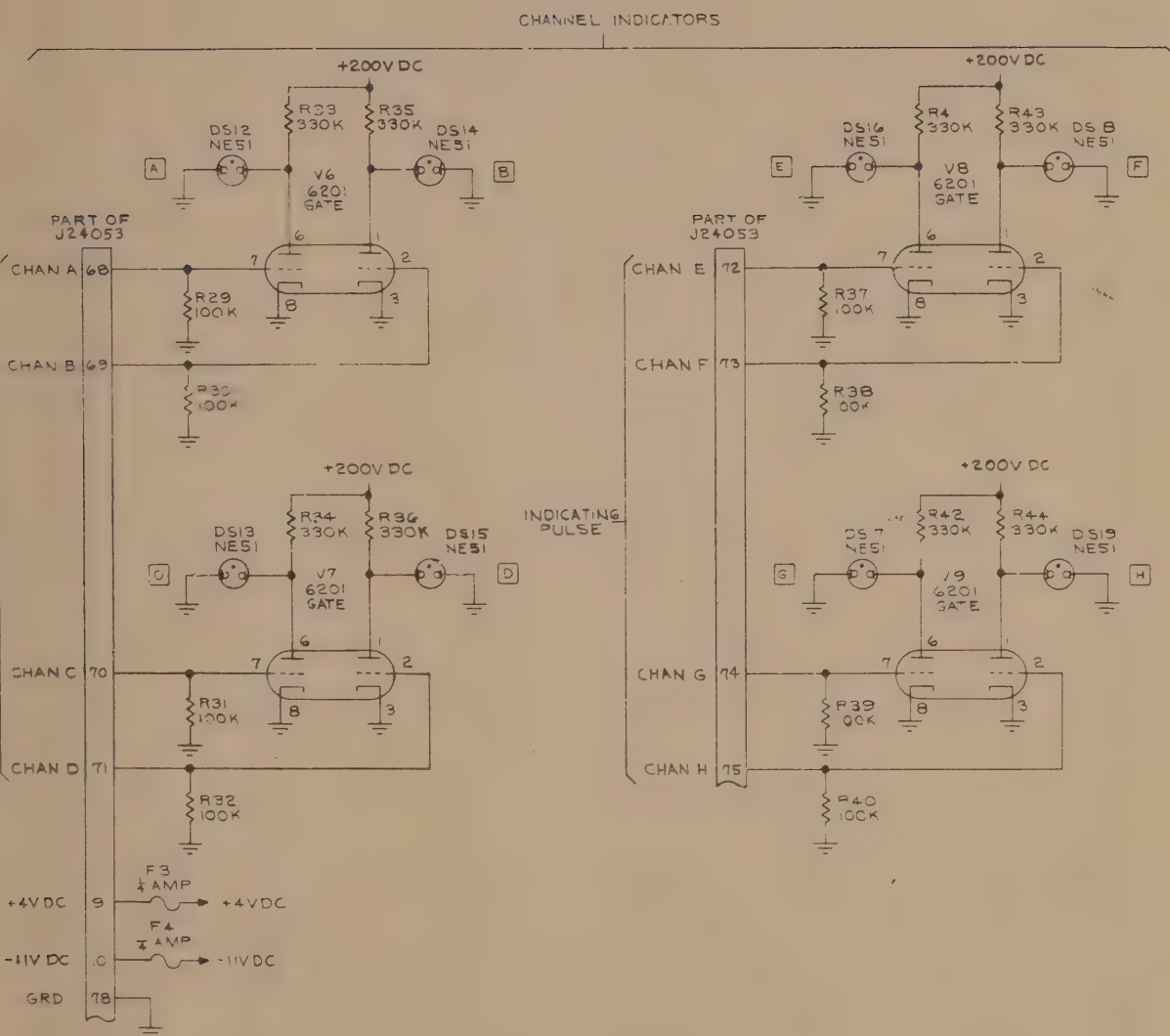


Figure 51. One-Line Manual Switchboard Schematic Diagram

NOTES

1. UNLESS OTHERWISE NOTED:
 A. RESISTORS ARE 1/2 WATT
 B. CAPACITORS ARE 100 P.F.

2. V.7. EXCEPTION OF JACS
 REFERENCE DESIGNATIONS
 ARE ABBREVIATED ADD
 4-000 TO REFERENCE NUMBER

3. SWITCH S3 IS VIEWED FROM
 OPPOSITE SIDE OF BOARD. MOTOR
 IS SHOWN IN OFF POSITION. SECTION 1 IS
 NEAREST THE CONTROL CAB
 END

4. CONTACT DESIGNATIONS ON
 S3 ARE ARBITRARILY AS-
 SIGNED

5. DIGIT GATE STAGES 1 THRU 11
 ARE SCHEMATICALLY IDENTICAL
 AS SHOWN IN DIGIT GATE
 STAGE 1. REFERENCE DE-
 SIGNATIONS ARE OBTAINED
 BY POSTFIXING A, B, C, D, E
 AND THE APPROPRIATE
 STAGE NUMBER TO REFERENCE
 DESIGNATIONS.

6. 1000 CPS DETECTOR THRU
 3000 CPS DETECTOR ARE
 SCHEMATICALLY IDENTICAL
 AS SHOWN IN 3000 CPS
 DETECTOR WITH EXCEP-
 TION OF 1 WHICH IS
 TUNED TO THE RESPECTIVE
 FREQUENCY. REFERENCE DE-
 SIGNATIONS ARE OBTAINED
 BY POSTFIXING A, B, C, D, E
 AND THE APPROPRIATE
 STAGE NUMBER TO REFERENCE
 DESIGNATIONS.

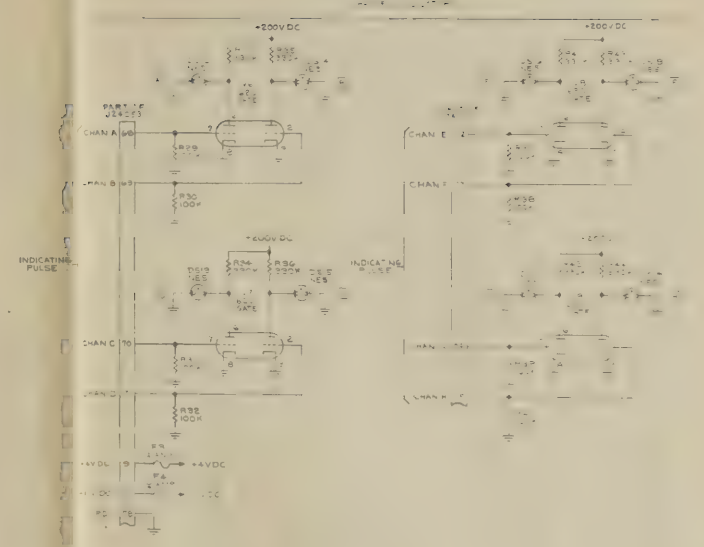
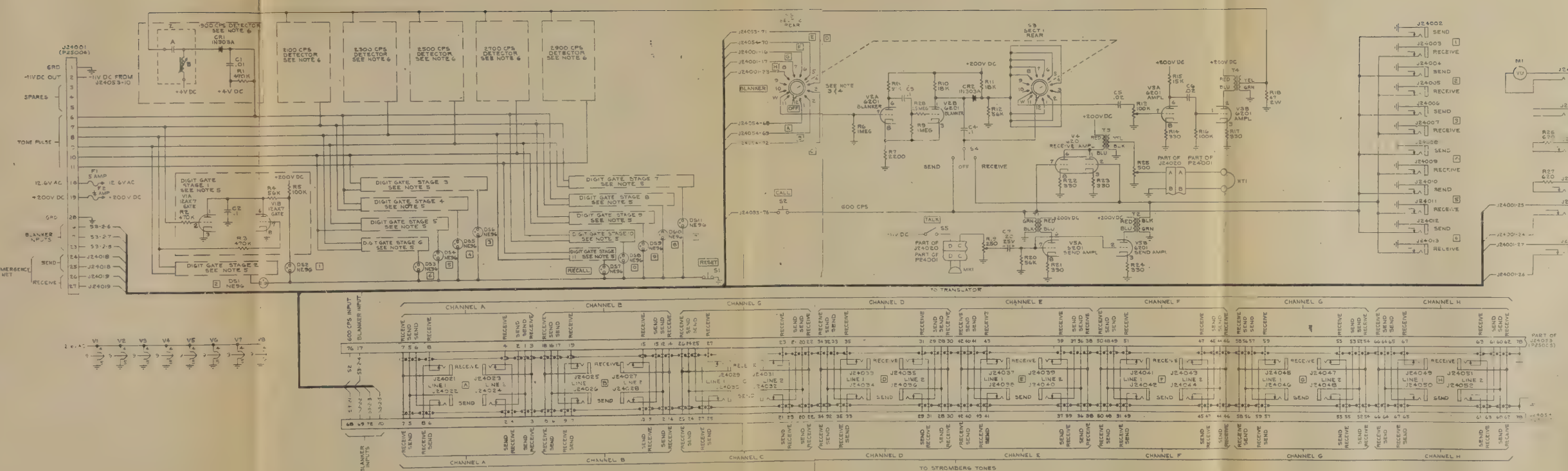
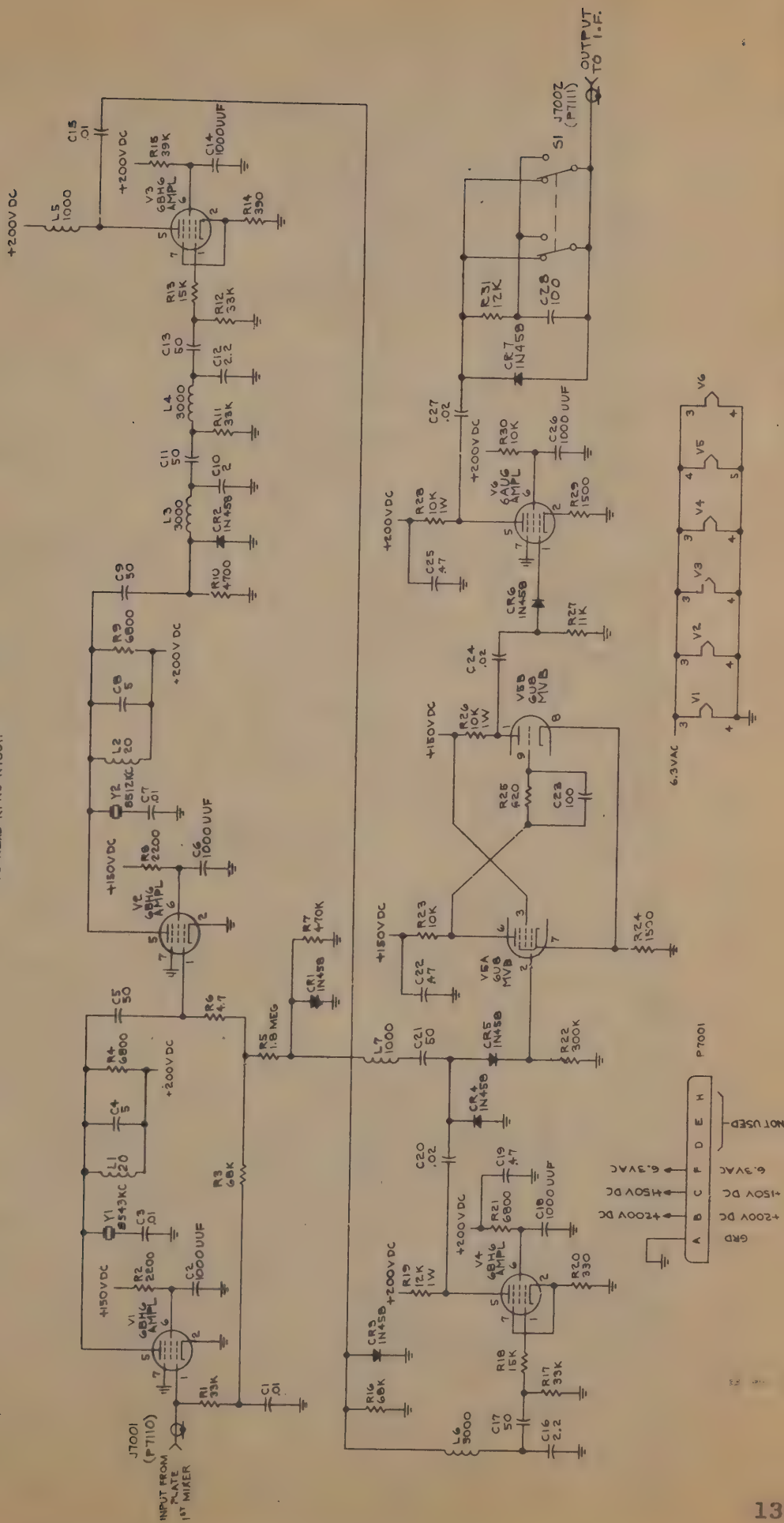


Figure 51. One-Line Manual Switchboard Schematic D



NOTES:
 1. UNLESS OTHERWISE INDICATED:
 ALL RESISTORS ARE IN OHMS, $\pm 5\% \frac{1}{2}$ WATT.
 ALL CAPACITORS ARE IN UF.
 ALL INDUCTORS ARE IN UH.

2. WITH EXCEPTION OF JACKS AND PLUGS, REFERENCE DESIGNATIONS ARE ABBREVIATED. ADD 7000 TO REFERENCE NUMBERS, THAT IS READ R1 AS R7001.

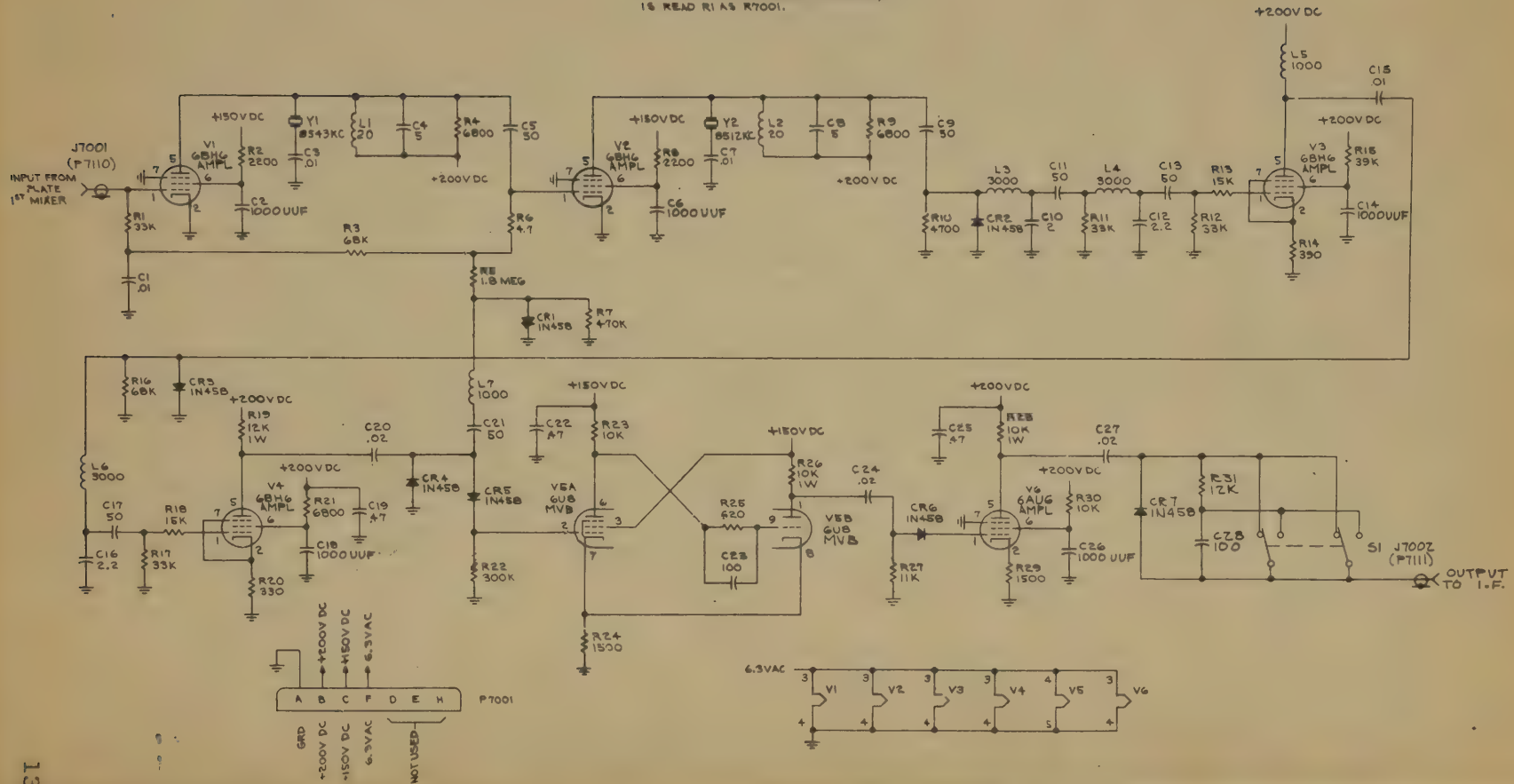


Figure 52. Central Station Noise Blanker Schematic Diagram

Figure 52. Central Station Noise Blanker
Schematic Diagram

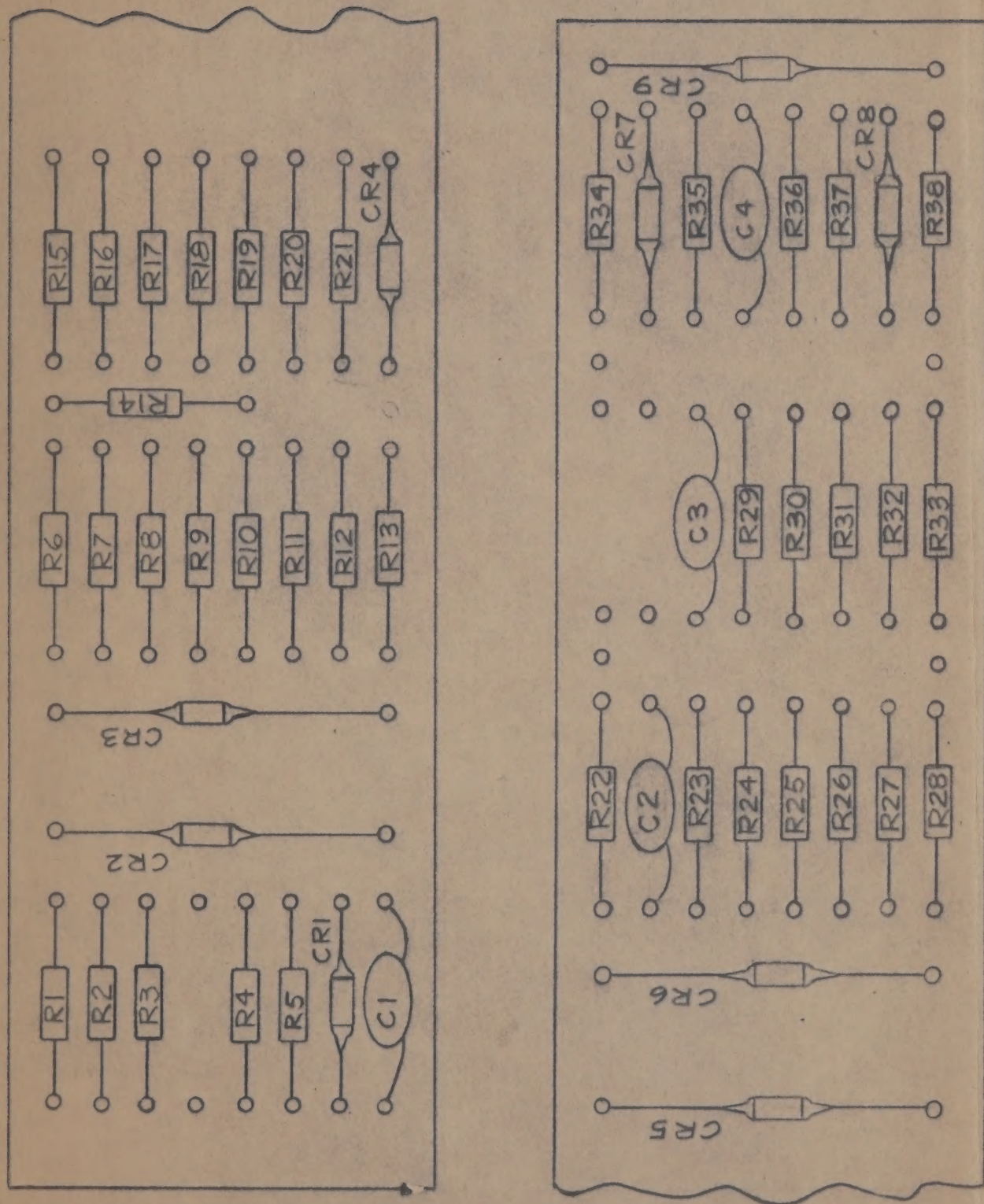


Figure 53. Central Station Decoder Chassis, Bottom View

